

**TM 5-3805-237-12**

**DEPARTMENT OF THE ARMY TECHNICAL MANUAL**

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# **OPERATOR AND ORGANIZATIONAL MAINTENANCE MANUAL**

**GRADER, ROAD, MOTORIZED: DIESEL ENGINE  
DRIVEN; 13,300 LB. PRESSURE AT BLADE; 12  
FT. BLADE; 6 WHEELS, 4 DRIVING, 2 STEERABLE;  
LEANING FRONT WHEELS; W/SCARIFIER  
(LETOURNEAU-WESTINGHOUSE MODEL 440HA)  
FSN 3805-931-7881**

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This copy is a reprint which includes current  
pages from Change 6

**HEADQUARTERS, DEPARTMENT OF THE ARMY  
MARCH 1967**

# SAFETY PRECAUTIONS

## BEFORE OPERATION

Before driving motor grader from the transporter, be sure there is enough ground clearance when negotiating the ramp.

Do not store acid-type batteries near stacks of tires; the acid fumes have a harmful effect on rubber.

Use care when removing blocking and straps so as not to damage motor grader.

When motor grader is to be used only in warm climates, remove container from cold weather starting aid. Inadvertent injection of the highly volatile fluid into the air intake of a warm engine could result in serious damage to the engine when started.

## DURING OPERATION

If changing direction of travel, bring motor

grader to complete stop before shifting.

When using cold weather starting aid, do not pull primer knob until cranking action starts. Serious damage to the engine could result.

## AFTER OPERATION

Before servicing any part of the motor grader electrical system, make certain that the battery disconnect switch is disengaged.

When removing battery cables, disconnect the ground cable first. When installing battery cables, connect the ground cable last. Any short circuit of the batteries can cause painful burns to personnel and damage to tools. A short circuited battery may explode and spray hot acid over the surrounding area.

CHANGE }

No. 6 }

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, D. C., 21 May 1974

**Operator and Organizational Maintenance Manual  
GRADER, ROAD, MOTORIZED: DIESEL ENGINE DRIVEN;  
13,300 LB. PRESSURE AT BLADE; 12 FT. BLADE;  
6 WHEELS, 4 DRIVING, 2 STEERABLE;  
LEANING FRONT WHEELS; W/SCARIFIER  
(LeTOURNEAU-WESTINGHOUSE MODEL 440HA)  
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TM 5-3805-237-12, 16 March 1967, is changed as follows:

*Page 1-1.* Paragraph 1-1 is superseded as follows:

**1-1. Scope.** *a.* This manual contains instructions for the use of operator and organizational personnel maintaining the motorized road grader as allocated by the Maintenance Allocation Chart. It provides information on the operation, lubrication, preventive maintenance checks and services and maintenance of the equipment, accessories and components. This manual also includes instructions on shipment.

*b.* You can help to improve this manual by calling attention to errors and by recommending improvements. Your letter or DA Form 2028

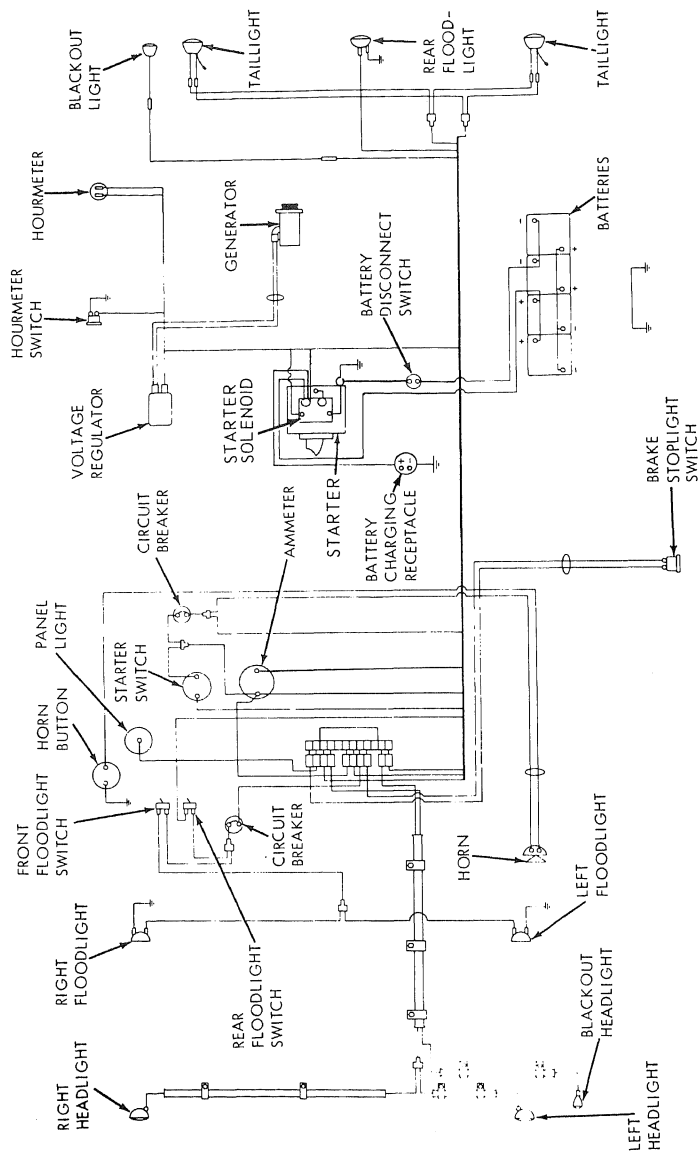
(Recommended Changes to Publications and Blank Forms) should be mailed direct to: Commander, US Army Troop Support Commander attn: AMSTS-MPP, 4300 Goodfellow Blvd, ST Louis, MO 63120. A reply will be furnished direct to you.

*Page 1-4.* Paragraph *b* (3)(j) is added after *b* (3)(i).  
(j) *Hydraulic system.*

Pumps	
Manufacturer	Hydreco
Type	Gear type, gear driven
Relief valve pressure	
(high idle)	
Steering	1150 to 1200 psi
Moldboard	1200 psi

*Page 1-5.* Figure 1-3 is superseded as follows:

\*This change supersedes C 1, 15 March 1968, C 2, 7 January 1969, C 3, 19 January 1970, C 4, 5 May 1971 and C 5, 9 May 1972.



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Figure 1-4. Wiring diagram.



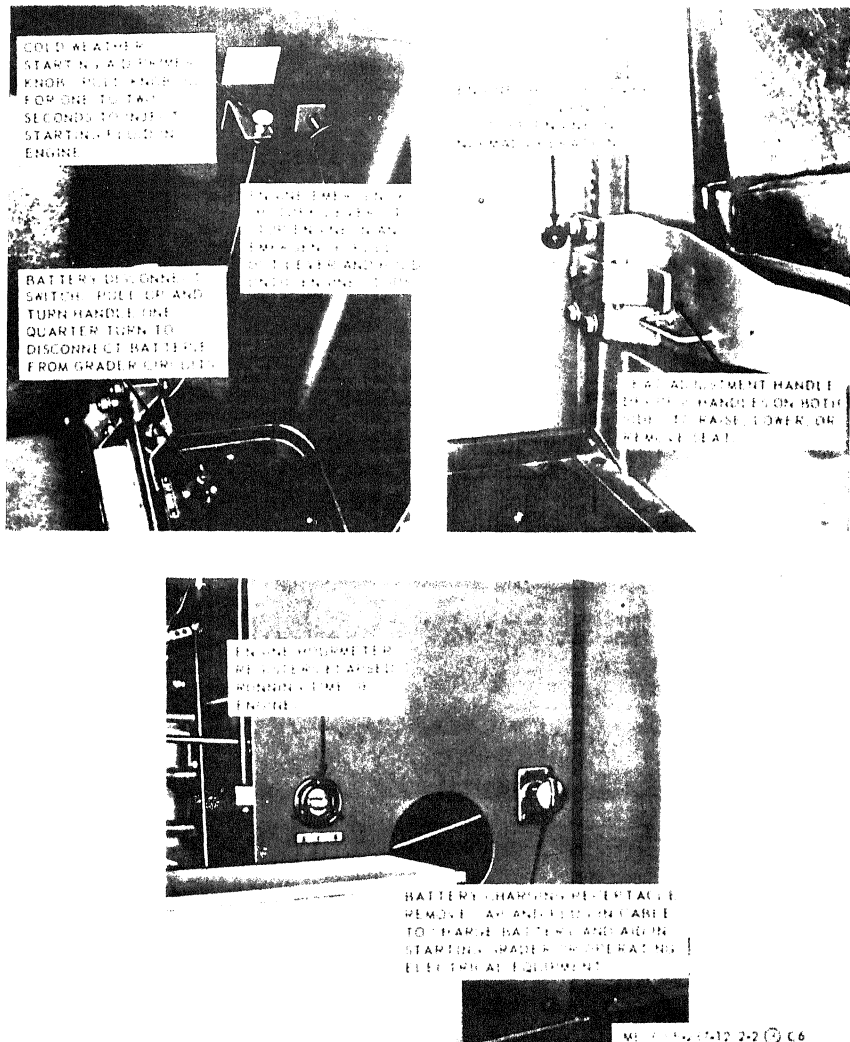


Figure 2-2©. Controls and instruments - continued.

Page 2-8. Paragraph 2-14b (4). Delete the first word "slowly" and add the following after the last sentence of the note: "Do not ride the clutch pedal".

Page 3-1. Paragraph 3-4c is superseded as follows:  
c. *Points of Lubrication.* Follow the detailed lubrication given on the current lubrication order, LO 5-3805-237-12. Always apply lubricants specified on the current lubrication order.

Paragraph 3-4d is superseded as follows:

d. Refer to LO 5-3805-237-12 for localized lubrication points.

Page 3-2 through page 3-13. Figure 3-2 (1) through 3-2 (12) is rescinded.

Page 3-14. Paragraph 3-4g is superseded as follows:

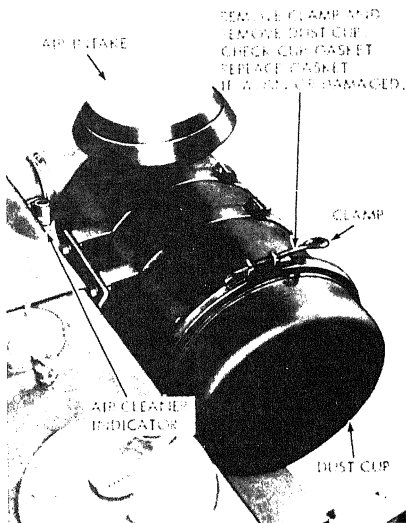
g. *Air cleaner service.* Refer to figure 3-5 and service the air cleaner. To clean, blow out cartridge from clean air side with a jet of low pressure, clean, dry, compressed air.

Add the following note after paragraph 3-4h:

#### NOTE

Keep the air cleaner under close surveillance, especially under adverse conditions as the air cleaner cartridge can become clogged within four hours.

Page 3-14. Figure 3-5 is superseded as follows:



NOTE: REMOVE DUST CUP DAILY. CLEAN CUP AND GASKET BY WIPING CLEAN WITH CLOTH. CHECK AIR CLEANER INDICATOR. IF RED PISTON RISES TO RED INDICATOR, REPLACE FILTER CARTRIDGE. REMOVE DUST CUP, REMOVE THUMB SCREWS AND REMOVE CARTRIDGE. CLEAN OR REPLACE CARTRIDGE EVERY 250 HOURS, REGARDLESS OF INDICATOR POSITION.

WH 45-10, 247 3-5 1-6

Figure 3-5. Air cleaner service.

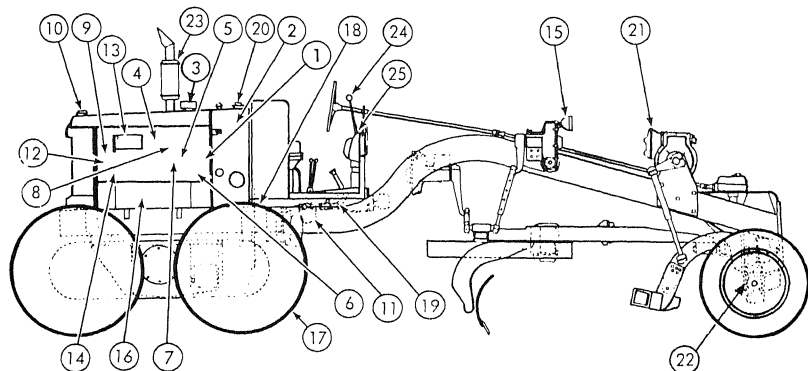
## PREVENTIVE MAINTENANCE SERVICES

### QUARTERLY

TM 5-3805-237-12

LETOURNEAU-WESTINGHOUSE MODEL 440HA

MOTOR GRADER



LUBRICATE IN ACCORDANCE WITH CURRENT LUBRICATION ORDER

ITEM		PAR REF
1	<b>FUEL FILTER AND STRAINER.</b> Inspect filter and strainer for insecure mounting and leaks at connections. Check fuel lines for leaks and damage. Drain water and sediment from shells. Install new filter and strainer elements.	3-9
2	<b>FUEL TANK.</b> Check for loose mounting and tighten if necessary. Check for leaking tank and replace if necessary. Check cap and vent. Replace cap gasket if necessary. Clean cap vent. Inspect fuel lines for leaks and damage. Clean fuel strainer at tank outlet.	3-41
3	<b>AIR CLEANER.</b> Check the air cleaner for serviceable condition. Replace defective air cleaner.	3-4
4	<b>MECHANICAL GOVERNOR.</b> Check governor linkage for free movement and correct operation. Oil linkage at joints.	3-43
5	<b>CRANKCASE OIL LEVEL GAGE.</b> Check oil level. Add oil as necessary. Reference current L.O.	3-4
6	<b>ENGINE OIL FILTER.</b> Check oil lines for leaks and damage.	3-4
7	<b>FUEL PUMP.</b> Check fuel lines for leaks and damage. Check fuel pump for loose mounting and damage. Check fuel flow.	3-40

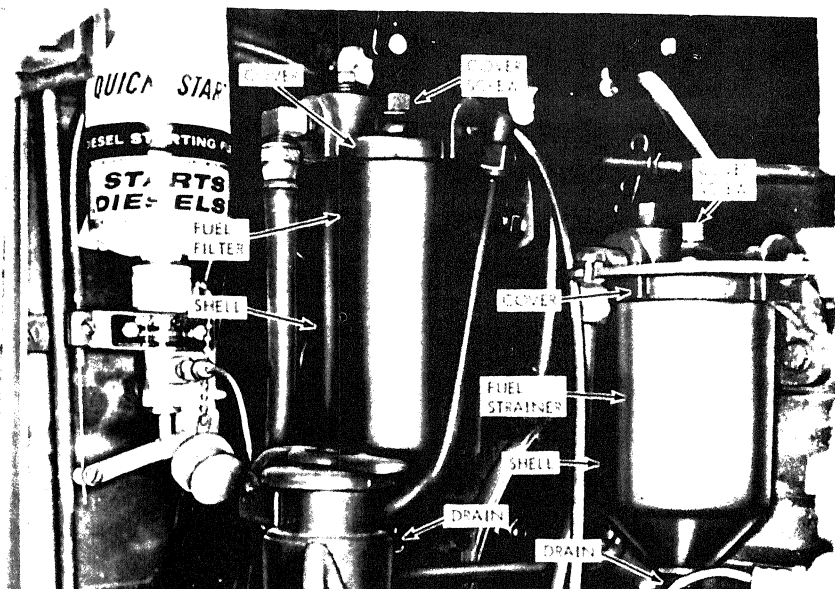
ME 3805-237-12 3-8 ① C6

*Figure 3-8 (1). Quarterly preventive maintenance services.*

ITEM		PAR REF
8	<u>INJECTOR NOZZLE AND HOLDER ASSEMBLIES.</u> Check nozzle and holder and lines for leaks and damage.	3-40
9	<u>WATER PUMP.</u> Inspect pump for leaks and loose mounting.	3-50
10	<u>RADIATOR.</u> Check for proper coolant level. Replace cracked or frayed hose. Replace leaking radiator. Clean air passages. Tighten all mountings and leaking connections. Check radiator cap for proper pressure.	3-48
11	<u>CLUTCH.</u> Check clutch pedal and linkage operation. Adjust if necessary. Free play should be approximately 2 inches.	3-39
12	<u>FAN BELT.</u> Check fan belt deflection. Correct deflection is 1/2 to 3/4-inch midway between pulleys. Adjust if necessary. Replace worn or stretched belts.	3-10
13	<u>GENERATOR.</u> Tighten loose mounting and electrical connections. Check regulator mounting and connections. Replace defective generator or regulator.	3-51
14	<u>STARTER.</u> Tighten loose mounting and electrical connections. Replace defective starter.	3-53
15	<u>LIGHTS.</u> Check running lights and floodlights for loose connections and damage. Replace defective lamp units or lights.	3-56
16	<u>BATTERIES.</u> Tighten loose cables and mounting. Clean corrosion from cables and batteries. Clean vent holes in filler caps. Perform a hydrometer test. Replace a weak, cracked, or leaking battery.	3-58
17	<u>TIRES.</u> Inspect tires for leaks and damage. Replace damaged tires.	3-67
18	<u>BREATHERS.</u> Clean breathers or replace damaged breathers.	3-62
19	<u>BRAKE CYLINDERS.</u> Inspect lines and cylinders for leaks. Replace defective cylinders and lines.	3-66
20	<u>HYDRAULIC RESERVOIR.</u> Inspect reservoir for leaks, damage and loose mounting. Tighten loose connections and mountings. Replace defective reservoir and lines. Replace filter elements.	3-68
21	<u>GEAR BOXES.</u> Inspect gear boxes and shafts for leaks and damage. Inspect control levers for damage. Replace defective shafts or control levers.	3-74
22	<u>TIE-ROD ENDS.</u> Inspect tie-rod ball ends for correct adjustment.	
23	<u>EXHAUST SYSTEM.</u> Check exhaust system for leaks and damage. Replace damaged or defective parts.	3-45
24	<u>CONTROLS.</u> Start engine and operate all vehicle controls. Check for proper operation. Adjust if necessary.	2-10
25	<u>INSTRUMENTS.</u> Inspect instruments for damage and insecure mounting. Replace defective instruments. Normal operating ranges for instruments are as follows: Ammeter Charge range Oil Pressure 30-60 psi Coolant Temperature 160-185°F	
	<u>NOTE 1. OPERATIONAL TEST.</u> During operation observe for any unusual noises or vibrations.	
	<u>NOTE 2. ADJUSTMENTS.</u> Make all adjustments during operational test.	

ME 3805-237-12/3-8 (2) C 6

Figure 3-8 (2). Quarterly preventive maintenance services  
(Cont'd).



NOTE: DRAIN WATER AND SEDIMENT FROM FILTER AND STRAINER DAILY.

- STEP 1. DRAIN FILTER OR STRAINER.
- STEP 2. REMOVE COVER SCREW.
- STEP 3. REMOVE SHELL FROM FILTER COVER. REMOVE GASKET FROM COVER.
- STEP 4. REMOVE FILTER OR STRAINER ELEMENT FROM SHELL.
- STEP 5. CLEAN SHELL WITH AN APPROVED CLEANING SOLVENT AND CLEAN CLOTH.
- STEP 6. AFTER INSTALLATION OF NEW ELEMENTS, PRIME FILTER AND STRAINER BY FILLING SHELL WITH CLEAN FUEL.
- STEP 7. INSTALL SHELL AND COVER GASKET IN COVER AND SECURE WITH COVER SCREW.

NOTE: CHANGE FILTER AND STRAINER ELEMENTS EVERY 250 HOURS OF OPERATION.

ME 3805-237-1, 3-9, C 6

Figure 3-9. Fuel filter and strainer service.

Page 3-22, paragraph 3-14. "(para 3-43)" is changed to read "(para 3-44)".

Page 3-23, paragraph 3-21. Possible remedy for

defective water pump is changed to read: "Replace water pump (para 3-50)".

Paragraph 3-24. Line 7, "(para 3-77)" is

changed to read "(para 3-79)".

Paragraph 3-25. Possible remedy for ball joints connecting to moldboard loose, change "(para 3-80)" to read "(para 3-79)".

Page 3-24, paragraph 3-30. Possible remedy for Hydraulic Lines leaking, change "(para 3-64)" to read "(para 3-66)".

Paragraph 3-31 is superseded as follows:

### 3-31. Parking Brake Does Not Hold Vehicle

*Possible Cause*

*Possible Remedy*

Brake or linkage out of	Adjust parking brake (para 3-66).
Brake lining worn.	Report this condition to direct support maintenance.
Brake drum or shoes damaged.	Replace brake drum or shoe.

Page 3-24. Paragraph 3-32 is superseded as follows:

### 3-32. Anti-Coast Brakes Do Not Function Properly

*Possible Cause*

*Possible Remedy*

Brake lining worn.	Replace brake band assembly (para 3-76).
Brake damaged or defective.	Replace damaged or defective brake parts (Para 3-76).

Page 3-25. Paragraph 3-39b is superseded as follows:

#### b. Free Pedal Travel Adjustment.

(1) Loosen locknuts (1, fig. 3-12) at each end of adjusting coupling (2).

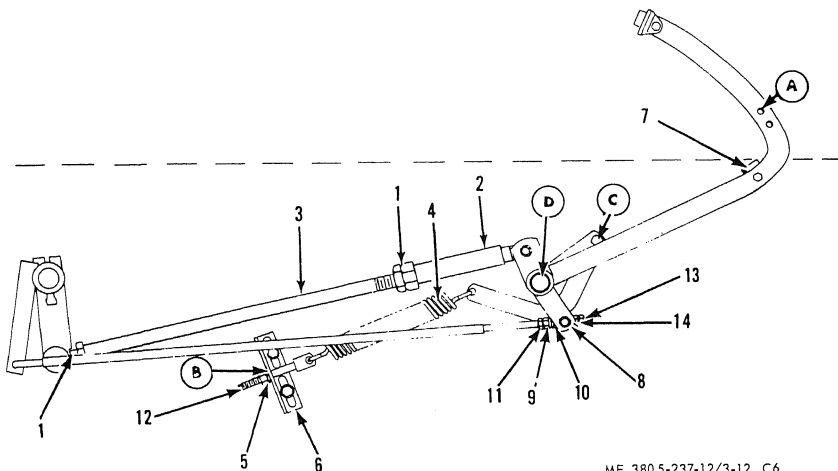
(2) Turn rod (3) in direction necessary to bring upper hole (A) in clutch pedal flush with top of floor plate at end of free pedal travel.

(3) Tighten locknuts and jamnuts (1) to hold adjustment.

(4) Adjust tension on spring (4) by loosening or tightening adjusting nut (5) at bracket (6) until distance between spring anchor hole in eyebolt and spring anchor hole in lever is 13 inches.

(5) Loosen screws holding angle bracket (6) and move bracket up or down until pedal can be positioned at the top or bottom of its free travel with approximately 5 pounds pressure. Tighten bracket screws. Spring stud hole (B) in bracket should be approximately in line with pivot points (C and D).

Page 3-26. Figure 3-12 is superseded as follows:



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- |                       |                   |
|-----------------------|-------------------|
| 1. LOCKNUT            | 8. SWIVEL         |
| 2. ADJUSTING COUPLING | 9. ADJUSTING NUT  |
| 3. PULL ROD           | 10. SPRING        |
| 4. SPRING             | 11. JAM NUT       |
| 5. ADJUSTING NUT      | 12. SPRING STUD   |
| 6. ANGLE BRACKET      | 13. JAM NUT       |
| 7. PEDAL LEVER PAD    | 14. ADJUSTING NUT |

Figure 3-12. Clutch Adjustment.

Page 3-26. Paragraph 3-39c is superseded as follows:

c. *Clutch Brake Adjustment.* With engine running, clutch brake must stop clutch in not less than three seconds after pedal has been fully depressed. Stopping the clutch greatly aids in shifting transmission without damage to gears.

(1) Loosen jamnut (11, fig. 3-12). Move adjusting nut (9) until spring behind nut is compressed to 5/8 inch in length when pedal is fully depressed.

(2) Tighten jamnut (11) against adjusting nut (9) to hold adjustment.

(3) Loosen jamnut (13) and tighten adjusting nut (14) against swivel finger to prevent rattle and looseness in linkage. Tighten jamnut (13).

(4) Check operation of brake and clutch under load to be sure adjustment is correct.

Page 3-27. Paragraph 3-42.1 is added after paragraph 3-42 as follows:

### 3-42.1. Fuel Injectors. a. General.

(1) Four fuel injectors supply fuel to the cylinders. The injectors build pressure and meter the fuel without use of a fuel injection pump.

(2) The timing of the injector rack controls the amount of fuel metered and injected into the cylinder.

(3) Type HV8 injectors (80-mm) are operated by rocker arms to inject fuel into the cylinders.

#### b. Removal.

(1) Refer to figure 3-21 and remove the engine hood.

(2) Loosen the two cover bolts and remove the rocker arm cover and gasket. Remove the cover studs if they are in the way.

(3) Disconnect and remove the fuel lines from the injectors. Be careful not to bend the lines. Install caps on the fuel injector inlet and outlet to prevent entrance of dirt.

(4) Bar the engine over to relieve rocker arm pressure on the injector and valve push rods of the injector to be removed.

(5) Remove two rocker shaft bracket bolts (fig. 3-14.1 (A)) and swing rocker arms away from injector and valves.

(6) Remove screw and washer securing injector clamp.

(7) Loosen inner and outer adjusting screws on injector rack control lever and slide lever away from injector.

(8) Remove injector from cylinder head with injector removal tool. Cover or plug hole to prevent foreign matter entering cylinder.

Page 3-27. Figure 3-14.1 (A) is added as follows:

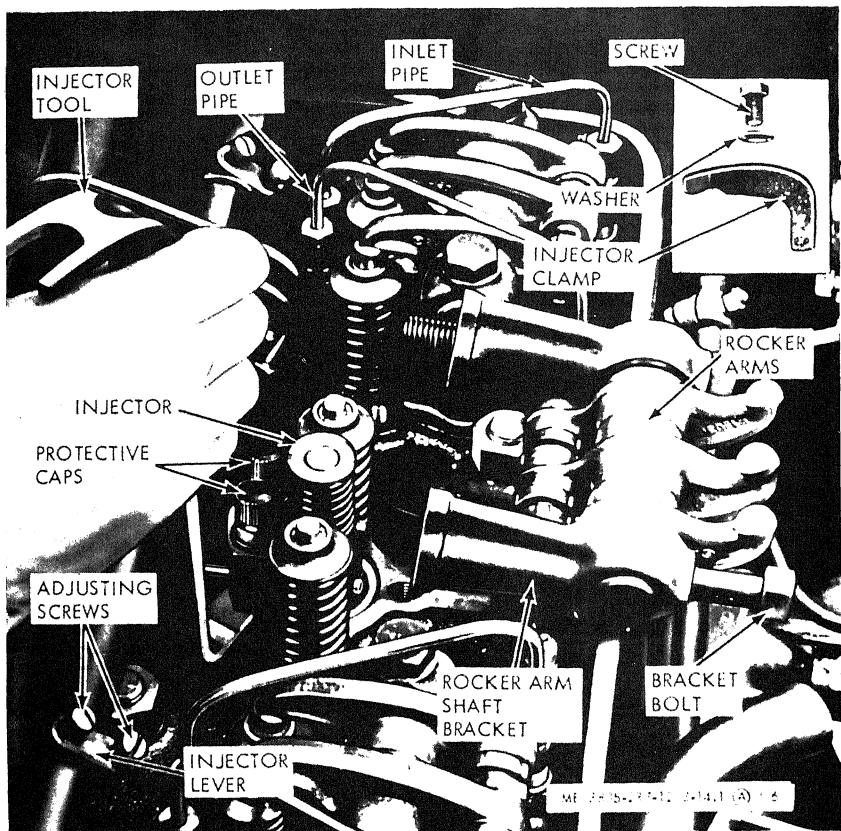


Figure 3-14.1 (A). Fuel injector removal and installation.



*c. Installation.*

**NOTE**

Prior to installation, check injector tube in cylinder head. Ream out carbon if necessary.

(1) Install injector in cylinder head with dowel pin in locating hole in cylinder head. Move injector lever to align with injector control rack.

(2) Install injector clamp and secure with screw and washer. Check placement of clamp so clamp does not interfere with valve or injector springs. Tighten screw to 20-25 foot-pounds torque.

**NOTE**

Check injector control rack for free movement.

(3) Move speed governor control over to maximum speed position, adjust inner and outer adjusting screws for full fuel rack position. When control lever is released, injector rack should be returned to its original position.

(4) Install rocker arm brackets and tighten bolts to 90 to 100 foot-pounds torque.

(5) Install fuel lines. Torque inlet lines to 12 to 15 foot-pounds. Do not tighten outlet lines.

(6) Set injector control rack in NO FUEL position (all the way out). Crank engine briefly to bleed any air from injector. Tighten outlet line to injector and torque to 12 to 15 foot-pounds.

**CAUTION**

Do not exceed torque specification, as excessive torque could twist or crack flared end of fuel line and result in fuel leaking into the crankcase.

*d. Adjustment and Timing.*

(1) Place engine governor speed control lever in NO FUEL position.

(2) Rotate the crankshaft until injector follower on the exhaust valve is fully depressed on the cylinder being adjusted.

(3) Loosen the push rod locknut. Place a 0.013-inch feeler gage between the valve stem and the rocker arm. Adjust the push rod to obtain a smooth "pull" on the feeler gage (fig. 3-14.1 (B)). Hold the push rod with the wrench and tighten locknut. Recheck the clearance. An 0.011-inch feeler gage should pass freely between the valve stem and rocker arm, but the 0.013-inch gage will not pass through.

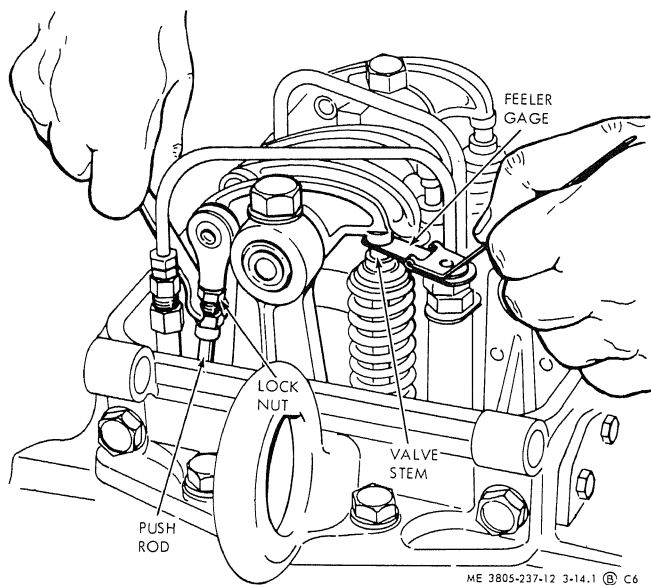
(4) Place the small end of the injector timing gage (General Motors Part No. 72-582-J1853) in the hole in the top of the injector body with the flat of the gage toward the injector follower (fig. 3-14.1 (C)).

(5) Loosen injector push rod locknut. Turn push rod and adjust injector rocker arm until extended part of gage will just pass over the top of the injector follower. Hold push rod with wrench and tighten locknut. Recheck adjustment.

(6) Start the engine and bring up to normal operating temperature (160°-185°F.). Recheck exhaust valve clearance with an 0.008-inch feeler gage which should pass through, but an 0.010-inch gage should not pass between the valve stem and the rocker arm.

(7) Install rocker arm cover and gasket and secure with cover bolts. Install engine hood.

*Page 3-27. Figure 3-14.1 (B) is added as follows:*



*Figure 3-14.1 (B). Continued.*

Figure 3-14.1 (C) is added as follows:

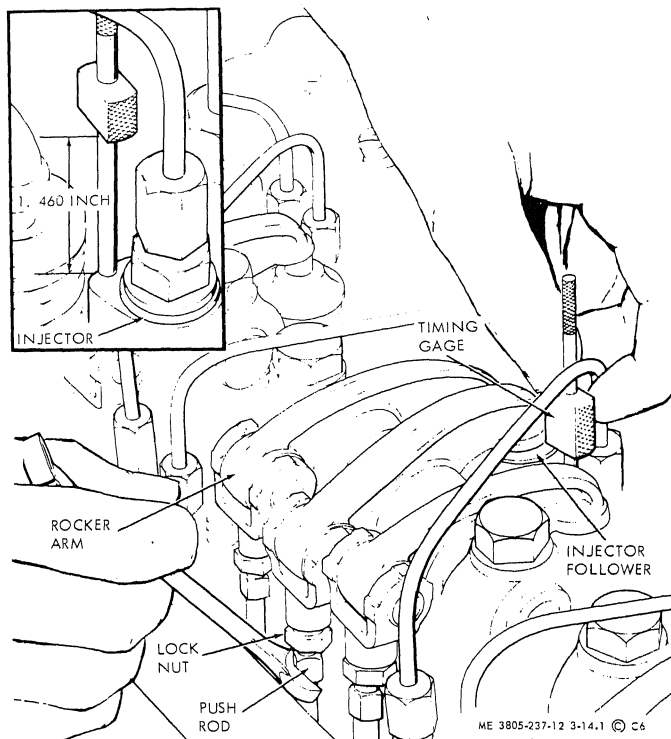
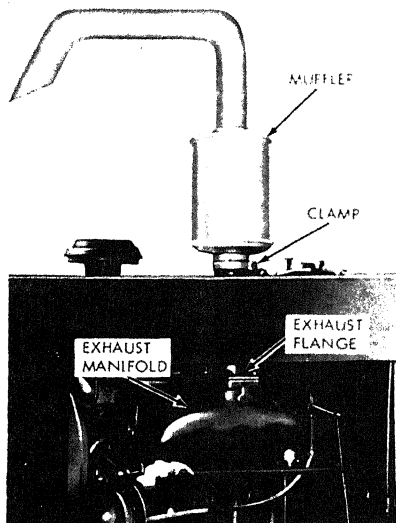


Figure 3-14.1 (C). Continued.

Page 3-28. Paragraph 3-43b is rescinded.  
Page 3-31. Figure 3-18 is superseded as follows:



NOTE: SHUTOFF ENGINE AND ALLOW EXHAUST SYSTEM TO COOL OFF BEFORE ATTEMPTING TO REMOVE COMPONENTS.

- STEP 1. LOOSEN CLAMP AND REMOVE MUFFLER FROM EXHAUST FLANGE.
- STEP 2. REMOVE FOUR SCREWS AND LOCKWASHERS AND REMOVE EXHAUST FLANGE FROM MANIFOLD.
- STEP 3. REMOVE AND INSPECT EXHAUST FLANGE GASKET. DISCARD GASKET IF DAMAGED OR LEAKAGE IS EVIDENT.

Page 3-39, paragraph 3-51. Subparagraph e is added after subparagraph d as follows:

*e. On Vehicle Generator and Voltage Regulator Test.*

(1) If ammeter shows high charging rate, operate engine at half throttle and disconnect field lead "B". If output remains high, generator or wiring is defective and must be replaced (fig. 3-26). If output drops, regulator is defective and must be replaced (fig. 3-27).

(2) If ammeter shows low charging rate, connect field lead "B" to ground. Slowly increase engine speed. If charging rate does not increase, generator is defective.

#### NOTE

After generator or voltage regulator replacement, before starting engine, momentarily connect a jumper between armature terminal "A" lead and battery terminal of regulator to polarize generator.

Paragraph 3-52. Subparagraph c is added as follows:

*c. On Vehicle Test.* Refer to paragraph 3-51.

Paragraph 3-53. Subparagraph c is rescinded.

Paragraph 3-53. Subparagraph d is added as follows:

*d. On Vehicle Test (fig. 3-28).*

(1) Remove solenoid to starter connector and connect voltmeter between the two terminals of solenoid. If voltage is indicated, solenoid is defective. Replace solenoid.

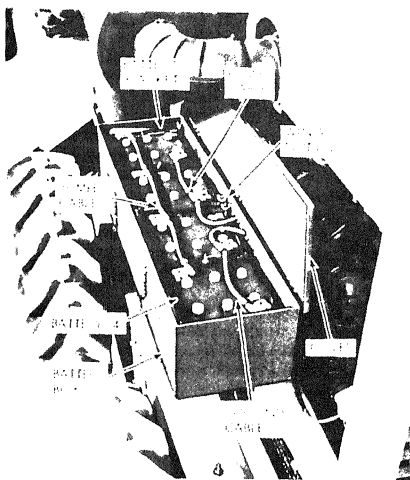
(2) Install solenoid to starter connector. Connect voltmeter to same terminals as listed in (1) above. If battery voltage does not show, starter is defective. Replace starter.

Page 3-41. Figure 3-29 is rescinded.

Page 3-47. Figure 3-36 is superseded as follows:

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Figure 3-18. Exhaust system removal and installation.



STEP 1. REMOVE BATTERY BANK COVER.  
STEP 2. DISCONNECT BATTERY CABLES FROM  
BATTERY BANK. DISCONNECT BATTERY  
CABLES FROM BATTERY BANK. DISCONNECT  
BATTERY CABLES FROM BATTERY BANK.

STEP 3. REMOVE BATTERY BANK COVER.  
STEP 4. REMOVE BATTERY BANK COVER.

STEP 5. REMOVE BATTERY BANK COVER.  
STEP 6. REMOVE BATTERY BANK COVER.

STEP 7. REMOVE BATTERY BANK COVER.  
STEP 8. REMOVE BATTERY BANK COVER.

STEP 9. REMOVE BATTERY BANK COVER.  
STEP 10. REMOVE BATTERY BANK COVER.

STEP 11. REMOVE BATTERY BANK COVER.  
STEP 12. REMOVE BATTERY BANK COVER.

STEP 13. REMOVE BATTERY BANK COVER.  
STEP 14. REMOVE BATTERY BANK COVER.

NOTE: TERMINAL POLARITY IS SHOWN  
ON BATTERY BOX.

ME 100-42742-7-10 (16)

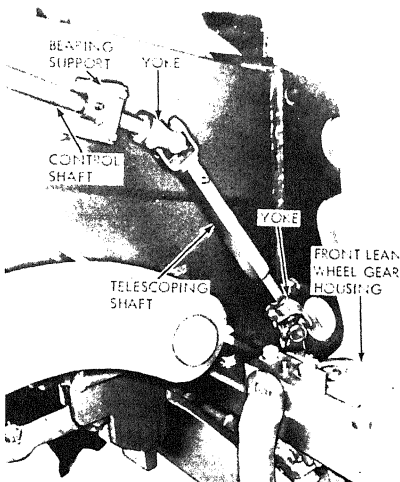
Figure 3-36. Batteries, removal and installation.

Page 3-54, paragraph 3-66. Subparagraph c is rescinded.

Subparagraph d (3) is added as follows:

(3) Removal. Shift transmission into gear. Drill out all staking on shaft locknut and remove nut. Remove brake drum. Remove shoe holddown

Page 3-53. Figure 3-42 is superseded as follows:



STEP 1. REMOVE FOUR SCREWS AND LOCK-  
WASHERS AND REMOVE CAPS FROM TWO  
BEARING SUPPORTS (FIG. 3-40) SUPPORT-  
ING FRONT LEAN WHEEL CONTROL  
SHAFT.

STEP 2. REMOVE SCREWS, NUTS, AND PINS AND  
DISCONNECT THREE YOKES (FIG. 3-40),  
FROM CONTROL SHAFT AND POWER  
CONTROL BOX.

STEP 3. REMOVE TWO SCREWS AND LOCK-  
WASHERS AND REMOVE CAP FROM  
BEARING SUPPORT.

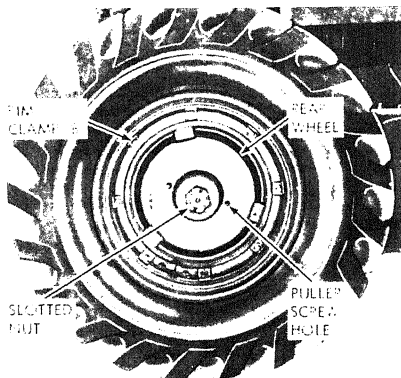
STEP 4. REMOVE SCREWS AND NUTS AND DIS-  
CONNECT YOKES FROM CONTROL  
SHAFT AND FRONT LEAN WHEEL GEAR  
HOUSING.

ME 100-42742-7-10 (16)

Figure 3-42. Front leaning wheel control shaft, removal and installation.

springs and pins, anchor to shoe springs. Disconnect cable from lever and remove shoes, adjusting screw, and strut. Install in reverse order. Torque locknut to 550-575 foot-pounds. Restake nut. Shift transmission to neutral.

Page 3-58. Figure 3-47 is superseded as follows:



STEP 1. REMOVE EIGHT NUTS AND RIM CLAMPS.

NOTE: ON FRONT WHEELS, REMOVE THREE SCREWS AND LOCK WASHERS AND REMOVE HUB CAP. REMOVE SCREW AND LOCK NUT AND REMOVE WHEEL NUT FROM AXLE.

NOTE: FRONT WHEELS CAN BE REMOVED WITHOUT USE OF PULLER SCREWS.

ME 3805-237-12 3-47 C6

Figure 3-47. Wheels, removal and installation.

Paragraph 3-69 is superseded as follows:

**3-69. Hydraulic Pump.** *a. General.* The steering hydraulic pump and the moldboard shift hydraulic pump are driven by a gear on the power box horizontal drive shaft.

*b. Removal and Installation.* Refer to figure 3-48. Page 3-61. Paragraph 3-76, subparagraph *a* (2) is superseded and subparagraphs *b* and *c* are added as follows:

(2) If adjustment does not correct operation, replace brake band assembly.

*b. Removal.* Remove upper and lower strap, adjusting nut, bolt, and compression spring. Slide brake band off drum.

*c. Installation.* Install in reverse order.

Paragraph 3-80 is superseded as follows:

**3-80. Circle Reverse Assembly.** *a. Gear Assembly.* Inspect gear assembly for leakage and damage. Inspect large circle reverse gear for damaged teeth. Operate controls and move circle reverse

through entire length of travel. Check operation of gear assembly and reversing pinion. Check retaining plates and shims at three points of suspension on drawbar.

*b. Adjustment.* For proper operation and a minimum of wear on the plates, the wear and retaining plates can be adjusted through the use of shims. Clearance must be maintained between the upper or wear plate and the top of the moldboard circle flange.

(1) Raise the moldboard clear of the ground with the moldboard circle in a horizontal position.

(2) Check clearance between wear plate and top of the flange. Vertical clearance should be 1/16 inch at all three points.

(3) If clearance is not 1/16 inch, lower moldboard to ground and remove retaining plate (fig. 3-51.1 (A)). Add or remove shims between lower or retaining plate and adjusting plate to provide required clearance. See note.

#### NOTE

When it is possible to achieve this clearance by removing shims, reverse position of retaining plate (place unworn side against circle) and add shims as necessary to provide clearance.

(4) Install plates and adjust for horizontal clearance. This can be adjusted with the wedges. In adjusting for horizontal clearance, the mesh of the ring gear with the drive gear must be also adjusted.

(5) Set the adjusting plates at all three points so the circle can be rotated.

(6) Note point at which drive gear meshes deepest with ring gear. Loosen jam nut on front and left adjusting plates. Move wedges with adjusting nut until adjusting plates contact the circle. Check clearance between drive gear teeth and ring gear. Minimum clearance is 3/16 inch between the top of the drive gear teeth and the bottom of the teeth in the ring gear.

(7) Use a 3/16-inch rod with two right angle bends. Place one end of rod at top of teeth and other end at bottom. Adjust plates by moving wedges to obtain this clearance (fig. 3-51.1 (B)).

(8) Check clearance between ring gear teeth and left side of circle reverse gear assembly. This clearance must be at least 1/8 inch.

(9) This adjustment is accomplished with the two rear adjusting plates. Loosen the wedges on the right rear block. Tighten wedges on left rear block to push circle out. Check adjustment and tighten wedge jam nuts.

(10) Check clearance between top of driving gear teeth and bottom of ring gear teeth. If adjustments have changed, adjust with front and left plates as in (6) above to get this clearance.

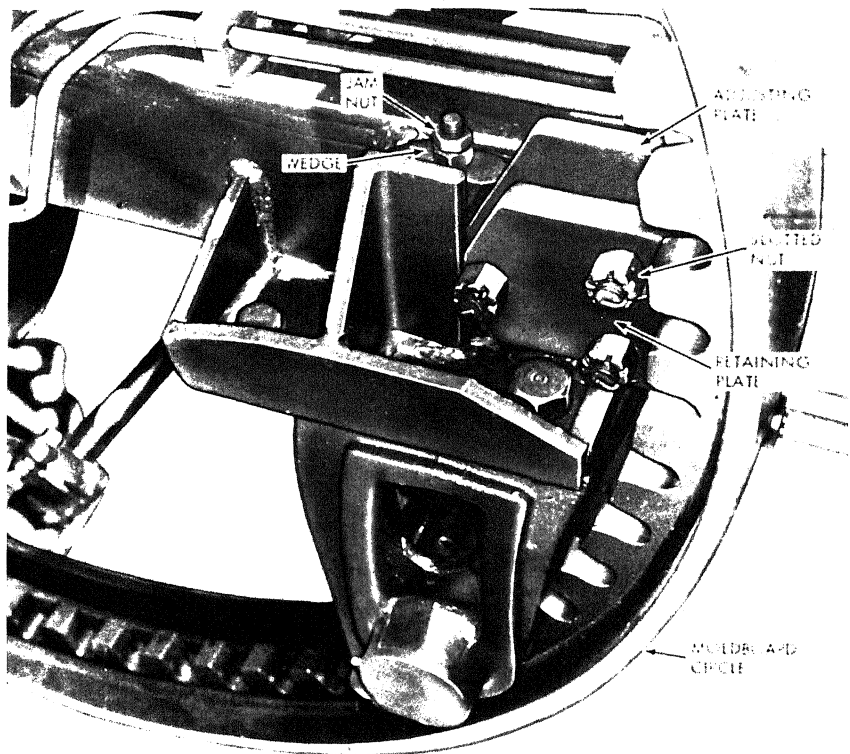
### CAUTION

The clearance between the top of the drive gear teeth and the bottom of the ring gear teeth must be  $\frac{3}{16}$  inch minimum to  $\frac{3}{8}$  inch maximum. Do not operate moldboard circle under load when clearance is more than  $\frac{3}{8}$  inch. Damage to circle reverse gear assembly could result.

(11) Tighten all wedge nuts and plate mounting nuts securely.

c. *Reversing Pinion.* Check reversing pinion clearance with circle gear. Note any wear spots on circle gear teeth. Wear should be even all around circle. If wear shows in certain areas, circle is out of alignment and three retaining plates and shims must be adjusted to align circle with reversing pinion.

*Page 3-61.* Figure 3-51.1 is added as follows:

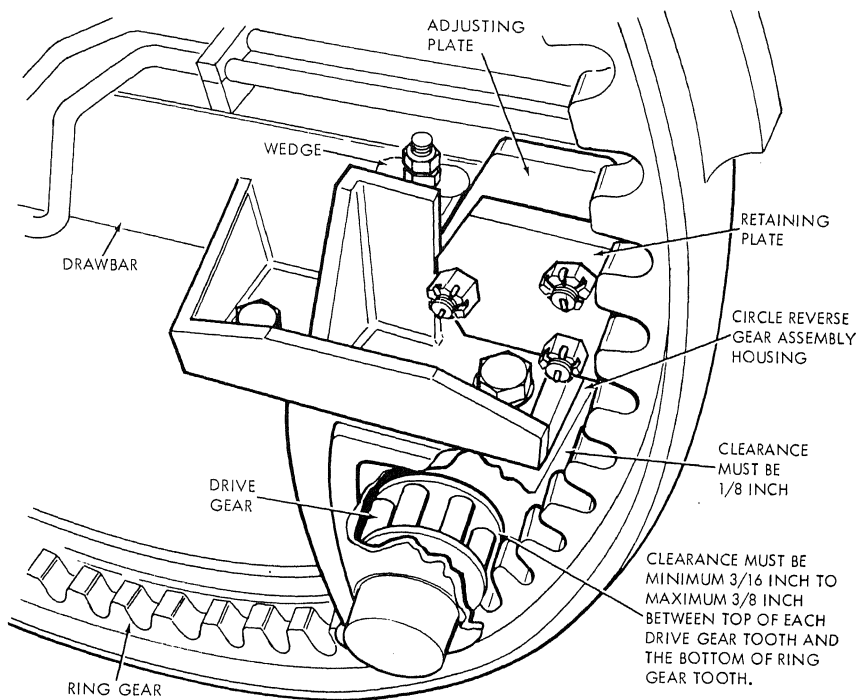


- STEP 1. REMOVE THREE JAM NUTS, LOCK WASHERS, NUTS, AND SCREWS. REMOVE SIX WEDGES.
- STEP 2. REMOVE NINE COTTER PINS, SLOTTED NUTS, FLAT WASHERS, AND SCREWS.
- STEP 3. REMOVE THREE RETAINING PLATES, ADJUSTING PLATES, SHIMS, AND WEAR PLATES FROM DRAWBAR.

ME 2225-237-12 3-51.1 (A) C6

*Figure 3-51.1 (A). Moldboard circle adjustment.*





ME 3805-237-12/3-51.1 (B) C6

Figure 3-51.1 (B). - Continued.

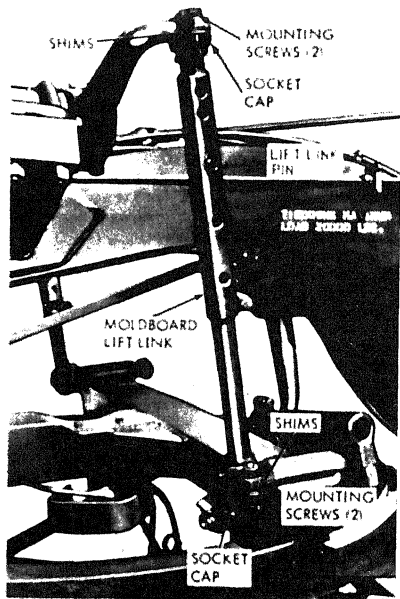
Page 3-63. Figure 3-53 is superseded as follows:

Page 3-63, paragraph 3-85. Note is superseded as follows:

**NOTE**

Always adjust end thrust bearing before adjusting clutch anti-coast brakes. Prior to adjusting thrust bearings, have all pressure on worm gear toward gear housing.

Page A-1. Appendix A is superseded as follows:



STEP 1. REMOVE TWO SCREWS, LOCKWASHERS, AND NUTS AND REMOVE SOCKET CAP.

STEP 2. REMOVE OR INSTALL SHIMS AS NECESSARY TO PROVIDE FREE MOVEMENT WITHOUT BINDING OR TOO MUCH FREE PLAY.

ME 1805-237-10, 2-53 (16)

Figure 3-53. Lift link shims, removal and installation.

## APPENDIX A REFERENCES

### 1. Fire Protection

TB 5-4200-200-10. . . . . Hand Portable Fire Extinguishers Approved For Army Users

### 2. Lubrication

C9100-IL. . . . . Identification List for Fuels, Lubricants, Oils and Waxes

LO 5-3805-237-12-1. . . . . Grader, Road, Motorized: Diesel Engine Driven; 13,300 Lb Pressure at Blade  
12 Ft Blade 6 Wheels; 4 Driving, 2 Steerable, Leaning Front Wheels;  
W/Engine GM Model 4057.

LO 5-3805-237-12-2. . . . . Grader, Road, Motorized: Diesel Engine Driven 13,300 Lb. Pressure at Blade:  
12 Ft Blade 6 Wheels 4 Driving, 2 Steerable, Leaning Front Wheels  
W/Scarifier (LeTourneau-Westinghouse Model 440HA) W/Engine GM  
Model 4057.

LO 5-3805-237-12-3. . . . . Grader, Road Motorized, Diesel Engine Driven 13,300 Lb Pressure at Blade;  
12 Ft Blade 6 Wheels 4 Driving, 2 Steerable Leaning Front Wheels  
W/Scarifier (LeTourneau-Westinghouse Model 440HA) W/Engine GM  
Model 40.57.

### 3. Painting

TM 9-213. . . . . Painting Instructions for Field Use

### 4. Radio Suppression

TM 11-483. . . . . Radio Interference Suppression

### 5. Maintenance

TB 750-651. . . . . Use of Antifreeze Solutions and Cleaning Compounds in Engine Cooling  
Systems

TM 5-3805-237-20P. . . . . Organizational Maintenance Repair Parts and Special Tools List: Grader,  
Road Motorized ded, 15,000 Lb Pressure at Blade, 12 Ft Blade, 6 Wheels 4  
Driving, 2 Steerable Leaning Front Wheels W/Scarifier (LeTourneau-  
Westinghouse Model 440HA) FSN 3805-931-7881.

TM 9-2610-200-20. . . . . Organizational care, maintenance and repair of pneumatic tires and inner  
tubes.

TM 9-6140-200-14. . . . . Operator, Organizational, Direct Support, and General Support Maintenance Manual Storage Batteries Lead-Acid Type

TM 38-750. . . . . The Army Maintenance Management Systems (TMMS)

### 6. Shipment and Storage

TM 740-90-1. . . . . Administrative Storage of Equipment

### 7. Destruction to Prevent Enemy Use

TM 750-244-3. . . . . Procedures for Destruction of Equipment to Prevent Enemy Use (Mobility  
Equipment Command)

*Page B-1.* Appendix B is superseded as follows:

# APPENDIX B

## BASIC ISSUE ITEMS LIST AND ITEMS TROOP INSTALLED OR AUTHORIZED

### Section I. INTRODUCTION

**B-1. Scope.** This appendix lists items required by the operator for operation of the grader.

<i>Code</i>	<i>Explanation</i>
C	Crew/Operator

**B-2. General.** This list is divided into the following sections:

a. *Basic Issue Items List - Section II.* Not applicable.

b. *Items Troop Installed or Authorized List - Section III.* A list of items in alphabetical sequence, which at the discretion of the unit commander may accompany the grader. These items are NOT subject to turn-in with the grader when evacuated.

(3) *Recoverability Code.* Indicates whether unserviceable items should be returned for recovery or salvage. Items not coded are non-recoverable. Recoverability codes are:

<i>Code</i>	<i>Explanation</i>
R...	Applied to repair parts (assemblies and components), special tools and test equipment which are considered economically repairable at direct and general support maintenance levels.
S...	Repair parts, special tools, test equipment and assemblies which are economically repairable at DSU and GSU activities and which normally are furnished by supply on an exchange basis.

**B-3. Explanation of Columns.** The following provides an explanation of columns in the tabular list of Basic Issue Items List, Section II, and Items Troop Installed or Authorized, Section III.

a. *Source, Maintenance, and Recoverability Code (s) (SMR).*

(1) *Source Code.* Indicates the source for the listed item. Source codes are:

<i>Code</i>	<i>Explanation</i>
P...	Repair parts, special tools and test equipment supplied from GSA/DSA or Army supply system and authorized for use at indicated maintenance levels.
P2...	Repair parts, special tools and test equipment which are procured and stocked for insurance purposes because the combat or military essentiality of the end item dictates that a minimum quantity be available in the supply system.

b. *Federal Stock Number.* This column indicates the Federal stock number assigned to the item and will be used for requisitioning purposes.

c. *Description.* This column indicates the Federal item name and any additional description of the item required.

d. *Unit of Measure (U/M).* A 2 character alphabetic abbreviation indicating the amount or quantity of the item upon which the allowances are based, e.g., ft, ea, pr, etc.

e. *Quantity Furnished With Equipment (BIIL).* Not applicable.

f. *Quantity Authorized (Items Troop Installed or Authorized).* This column indicates the quantity of the item authorized to be used with the equipment.

### Section III. ITEMS TROOP INSTALLED OR AUTHORIZED LIST

Federal stock number	Description	U/M	Qty. Auth.
7520-559-9618	CASE, Maintenance and Operation Manuals	EA	1
4210-889-2221	EXTINGUISHERS, Fire	EA	1
4910-922-6921	KIT, Tubeless Tire Repair	EA	1
7240-408-3985	MEASURE, 1 Qt. Flex. Extension	EA	1
5120-595-9182	WRENCH, Allen, 9/16 In.	EA	1
5120-203-4804	WRENCH, Open End, 1 1/2 In.	EA	1

Page C-1. Appendix C is superseded as follows:

# APPENDIX C MAINTENANCE ALLOCATION CHART

## Section I. INTRODUCTION

1. **General.** *a.* This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

*b.* Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

*c.* Section III lists the special tools and test equipment required for each maintenance function as referenced from Section II.

*d.* Section IV contains supplemental instructions, explanatory notes and/or illustrations required for a particular maintenance function.

2. **Explanation of Columns in Section II.** *a. Group Number, Column (1).* The functional group is a numerical group set up on a functional basis. The applicable functional grouping indexes (obtained from TB 750-93-1, Functional Grouping Codes) are listed on the MAC in the appropriate numerical sequence. These indexes normally are set up in accordance with their function and proximity to each other.

*b. Functional Group, Column (2).* This column contains a brief description of the components of each functional group.

*c. Maintenance Functions, Column (3).* This column lists the various maintenance functions (A through K) and indicates the lowest maintenance category authorized to perform these functions. The symbol designations for the various maintenance categories are as follows:

- C — Operator or crew
- O — Organizational maintenance
- F — Direct support maintenance
- H — General support maintenance
- D — Depot maintenance

The maintenance functions are defined as follows:

A — **INSPECT.** To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.

B — **TEST.** To verify serviceability and to detect electrical or mechanical failure by use of test equipment.

C — **SERVICE.** To clean, to preserve, to charge, to paint, and to add fuel, lubricants, cooling agents, and air.

D — **ADJUST.** To rectify to the extent necessary to bring into proper operating range.

E — **ALINE.** To adjust specified variable elements of an item to bring to optimum performance.

F — **CALIBRATE.** To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparisons of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.

G — **INSTALL.** To set up for use in an operation environment such as an emplacement, site, or vehicle.

H — **REPLACE.** To replace unserviceable items with serviceable assemblies, subassemblies, or parts.

I — **REPAIR.** To restore an item to serviceable condition. This includes, but is not limited to, inspection, cleaning, preserving, adjusting, replacing, welding, riveting, and strengthening.

J — **OVERHAUL.** To restore an item to a completely serviceable condition as prescribed by maintenance serviceability standards using the Inspect and Repair Only as Necessary (IROAN) technique.

K — **REBUILD.** To restore an item to a standard as nearly as possible to original or new condition in appearance, performance, and life expectancy. This is accomplished through complete disassembly of the item, inspection of all parts or components, repair or replacement of worn or unserviceable elements (items) using original manufacturing tolerances and specifications, and subsequent reassembly of the item.

*d. Tools and Equipment, Column (4).* This column is provided for referencing by code the special tools and test equipment (Section III), required to perform the maintenance functions (Section II).

*e. Remarks, Column (5).* This column is provided for referencing by code the remarks (Section IV) pertinent to the maintenance functions.

3. **Explanation of Columns in Section III.** *a. Reference Code.* This column consists of a number and a letter separated by a dash. The number references the tools and equipment requirements

column on the MAC. The letter represents the specific maintenance function the item is to be used with. The letter is representative of columns A through K on the MAC.

*b. Maintenance Level.* This column shows the lowest level of maintenance authorized to use the special tool or test equipment.

*c. Nomenclature.* This column lists the name or identification of the tool or test equipment.

*d. Tool Number.* This column lists the manufacturer's code and part number, or Federal

stock number of tools and test equipment.

**4. Explanation of Columns in Section IV. a. Reference Code.** This column consists of two letters separated by a dash, both of which are references to Section II. The first letter references column 5 and the second letter references a maintenance function, column 3, A through K.

*b. Remarks.* This column lists information pertinent to the maintenance function being performed, as indicated on the MAC, section II.

## Section II — MAINTENANCE ALLOCATION CHART

(1) Group No.	(2) Assembly Group	(3) Maintenance functions											(4) Tools and equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
01	ENGINE													
0100	Engine Assembly Engine	C 0.5	F 1.5	C 0.5					F 12.3	F 1.0	D 85.0			A-B
0101	Crankcase, Block, Cylinder Head Head, cylinder								F 3.0	H 2.0				
0102	Crankshaft Pulley								F 5.5	F 3.0				
0103	Flywheel Assembly Flywheel, housing, ring gear								H 3.0	H 1.0				
0105	Valves, Camshafts, and Timing System Arm, rocker				O 1.0				F 3.0	F 3.0				
	Tappets				F 1.5				H 3.0					
	Valves, Seats								H 5.5	H 3.0				
0106	Engine Lubricating System Breather			C 0.4					O 0.1					
	Pump, oil								H 0.6	H 1.5				
02	CLUTCH													
0200	Clutch Assembly Clutch assembly				F 0.5									
	Disk, plates								H 5.0					
0202	Clutch Release Mechanism Bearings, shaft, yoke			O 0.5					H 5.0					
	Pedal, linkage				O 0.5				O 1.5					
0206	Clutch, Brake Hub, plate				F 0.5				H 2.0					

(1) Group No.	(2) Assembly Group	(3) Maintenance functions											(4) Tools and equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
03	FUEL SYSTEM													
0301	Fuel Injector Injector, fuel		F 0.5		O 0.3				O 2.5	H 1.5				
0302	Fuel Pumps Pump, fuel transfer		O 1.3						O 0.8	F 1.5				
0304	Air Cleaner Cleaner, air, cartridge			C 0.5					O 1.0					
0305	Blower								F 8.8	H 4.8				
0306	Tanks, Lines, Fittings Cap, fittings, lines								O 1.0	O 0.5				
	Tank	C 0.2		C 0.3					O 2.0	F 1.0				
0308	Engine Speed Governor and Controls Governor				F 1.5				F 1.5	D 3.0				
0309	Fuel Filters Filter, fuel			C 0.5					O 0.5					
0311	Starting Aid								C 0.3	O 0.4				
05	COOLING SYSTEM													
0501	Radiator Core, tanks								F 5.0	F 4.0				
	Radiator	C 0.1		C 0.5					O 3.5	F 2.0				
0504	Water Pump Pump, water								O 1.5	F 1.5				
0505	Fan Assembly Belt, vee	C 0.1			C 0.2				O 0.5					
	Tightener, belt			C 0.1					O 0.3					
06	ELECTRICAL SYSTEM													
0601	Generator Belt, vee	C 0.1			C 0.2				O 1.0					
	Generator		O 0.5	C 0.2					O 0.7	F 3.0				
0602	Generator Regulator Regulator generator		O 0.3		O 0.4				O 0.5					
0603	Starting Motor Starter		O 0.2						O 0.8	F 3.0				
0607	Instrument or Engine Control Panel Wiring									O 1.0				
0608	Miscellaneous Items Wiring								O 1.0	O 0.5				

1 Group No.	2 Assembly Group	3 Maintenance functions										4 Tools and equipment	5 Remarks
		A	B	C	D	E	F	G	H	I	J		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul		
0611	Horn Wiring								O 0.5	O 0.5			
0612	Batteries		O 0.4	C 0.5					O 0.6				
	Batteries								O 1.0	O 0.5			
	Cables												
0613	Chassis Wiring Harness								F 1.5	O 0.5			
	Harness, wiring												
0615	Radio Interference suppression Components		O 0.5						O 1.0				
07	TRANSMISSION												
0700	Transmission Assembly								H 15.0	H 20.0			
	Transmission	C 0.2		C 0.5									
09	PROPELLER AND PROPELLER SHAFTS												
0900	Propeller Shafts								F 1.0	F 1.5			
	Shaft, clutch drive												
	Shaft, power control box drive								O 1.0	O 1.5			
10	AXLE												
1000	Front Axle Assembly								F 3.0	F 5.0			
	Axle assembly, front			C 0.3									
1004	Steering and Leaning												
	Wheel Mechanism								O 3.0	F 6.0			
	Gear box assembly	C 0.5		C 0.4									
	Knuckles, arms, shafts bearings, seals, flanges, pins; gear case, gears				F 0.5				F 3.0				
	Shafts, bushings			C 0.5					C 3.5				
	Shafts, control joints universal								O 2.5	O 3.0			
11	REAR AXLE												
1103	Final Drive								H 18.5	H 21.0			
	Final drive assembly			C 0.5									
1105	Tandem Drive Assembly								H 16.5	H 18.0			
	Carrier axle assembly			C 0.5					F 10.0	F 4.0			
	Chain, drive												
1108	Walking Beams, Stud Axles and Parts								H 7.0	H 5.0			
	Axle drive assembly			C 0.5									
1201	Hand Brakes								O 2.5	F 4.0			
	Drum												



(1) Group No.	(2) Assembly Group	(3) Maintenance functions											(4) Tools and equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
1201	Hand Brakes (Cont'd) Lever, linkage				C 0.4				O 1.5					
	Shoe assembly				O 0.5				O 2.5	F 2.5				
1202	Service Brakes Brakes, service				O 0.4				F 4.0	F 1.0				
	Shoe assembly								F 5.0	F 6.0				
1204	Hydraulic Brakes System Cylinder, master	C 0.2		C 0.3					O 2.5	F 3.0				
	Cylinder, wheel								F 6.5	F 8.0				
1206	Mechanical Brake Controls Pedal, brackets, linkage, rods				O 0.5				O 2.5					
13	WHEELS													
1311	Wheel Assembly Bearings, seals (front)			C 2.0		O 1.0			O 4.0					
	Drums								F 2.0	F 5.5				
1313	Tires Tires			C 0.5					O 2.0	O 0.5				
14	STEERING													
1401	Steering Assembly Shafts, draglinks, arm			C 0.6 C 0.3					O 2.5 F 3.5	O 3.0 F 4.0				
	Steering gear assembly													
1410	Hydraulic Pump Pump, hydraulic		O 0.4						O 1.5	F 4.0				
1414	Steering System Valves Valve assemblies								O 1.5	F 3.0				
15	FRAME, TOWING ATTACH- MENTS													
1503	Pintles and Towing Attachments Hook, pintle			C 0.1					O 1.0	O 1.0				
20	POWER CONTROL UNIT													
2002	Power Control Unit Assembly Brake band Control assembly Shaft, Propeller	C 0.1		C 0.3 C 0.1	C 0.5				O 2.0 F 1.5 O 1.0	F 2.0 O 1.5				

(1) Group No.	(2) Assembly Group	(3) Maintenance functions										(4) Tools and equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K	
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	
43	HYDRAULIC SYSTEM												
4301	Filters, Hoses, Fittings Tubing												
	Filter, hydraulic oil			C					C				
	Junction assembly			0.5					0.5				
				C					O				
4302	Pump and Pump Drives			0.5					0.5	F			
				O					O				
4305	Control Valves			0.2					4.9	3.0			
	Valves								O	F			
4307	Hydraulic Cylinders								1.0	2.0			
	Cylinder, hydraulic								F	F			
									1.5	3.0			
74	EARTH MOVING EQUIP- MENT COMPONENTS												
7435	Moldboard Assembly												
	Blade assembly								O	F			
									1.0	2.5			
	Moldboard assembly				C				O	F			
					0.2				1.0	1.5			
7436	Lift, Arms and Pivot Assemblies								O				
	Bar, links, arms			C	C				O				
				0.1	1.0				3.0				
7438	Circle and Drawbar Assem- bly								F	F			
	Circle, drawbar			C	O				2.5	4.0			
				0.1	0.4								
7439	Circle Reverse Drawbar Shift & Lift Mechanism								O	F			
	Gear box assembly			C	C				2.0	3.0			
				0.1	0.1				O	O			
	Joints, universal								1.5	2.0			
7440	Scarifier Assembly												
	Drawbar, rods, bushings, angle adjustments, shanks				C				O				
					0.3				3.0				
	Teeth				C				C				
					0.5				0.5				
7441	Scarifier Actuating			C	C				O	F			
				0.1	0.1				1.0	1.5			
	Gear box assembly			C	C				O	F			
				0.2	0.2				3.0	5.0			
	Joints, universal			C	C				O	O			
				0.1	0.1				1.5	2.0			
	Shafts, arms, bushings			C					O				
				0.1					2.0				
76	FIRE FIGHTING EQUIPMENT												
7603	Fire Extinguishers												
	Extinguisher, fire			C					C				
				0.5					0.1				

1-H

### Section III. SPECIAL TOOL AND SPECIAL TEST EQUIPMENT REQUIREMENTS

Reference code	Maintenance level	Nomenclature	Tool number
I-H	C	Remover, scarifier point	429581 (35311)

### Section IV. REMARKS

Reference code	Remarks
A-B	Test includes engine operation and compression.

By Order of the Secretary of the Army:

Official:

VERNE L. BOWERS

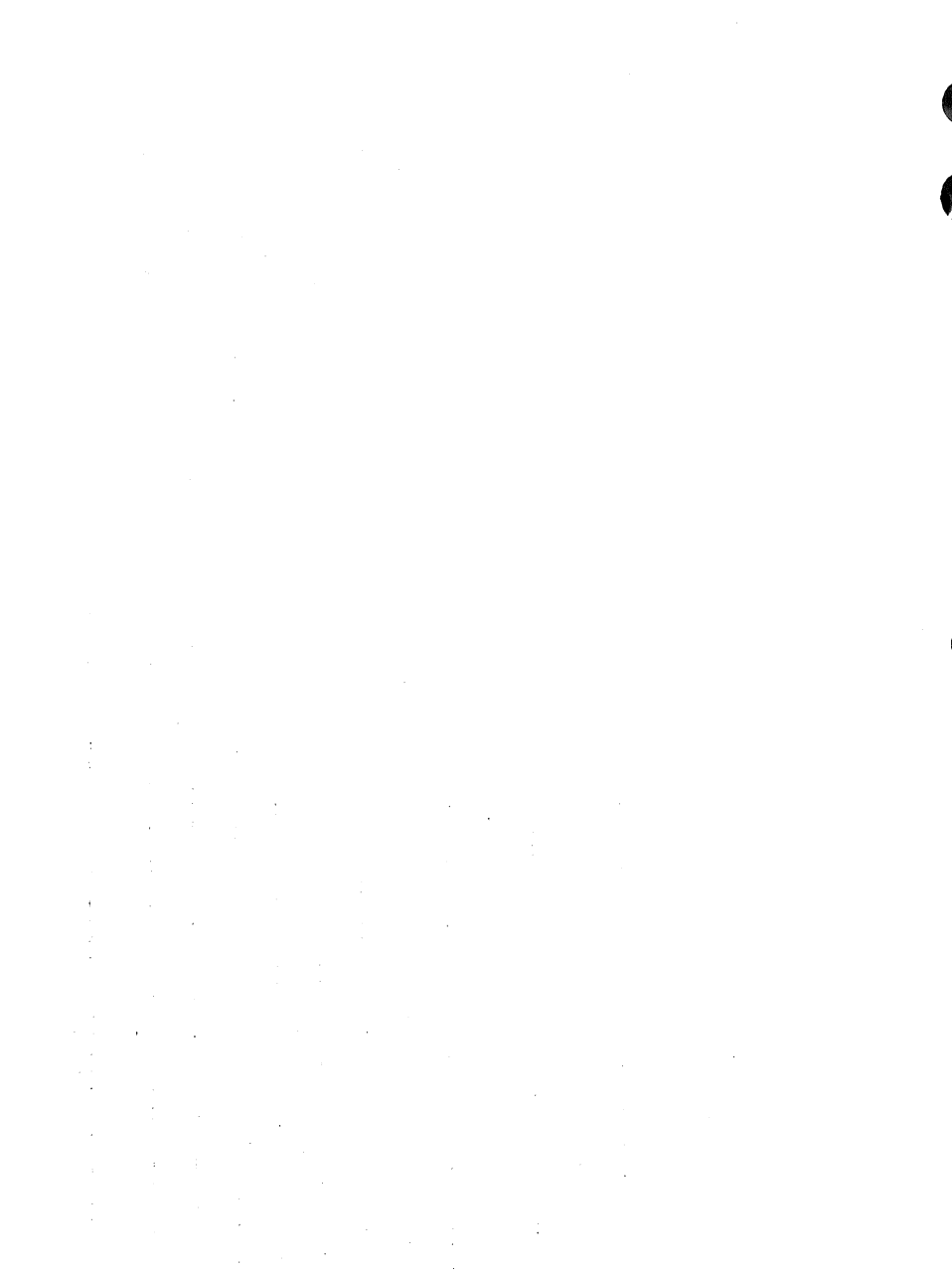
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*The Adjutant General*

CREIGHTON W. ABRAMS  
*General, United States Army*  
*Chief of Staff*

Distribution:

To be distributed in accordance with DA Form 12-25B (qty rqr block no. 394), Organizational maintenance requirements for Earth Moving Equipment: Graders.



**OPERATOR AND ORGANIZATIONAL MAINTENANCE MANUAL**  
**GRADER, ROAD, MOTORIZED: DIESEL ENGINE DRIVEN; 13,300 LB**  
**PRESSURE AT BLADE; 12 FT. BLADE; 6 WHEELS, 4 DRIVING, 2 STEERABLE;**  
**LEANING FRONT WHEELS; W/SCARIFIER (LeTOURNEAU-WEST-**  
**INGHOUSE MODEL 440HA)**  
**FSN 3805-931-7881**

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# CHAPTER 1

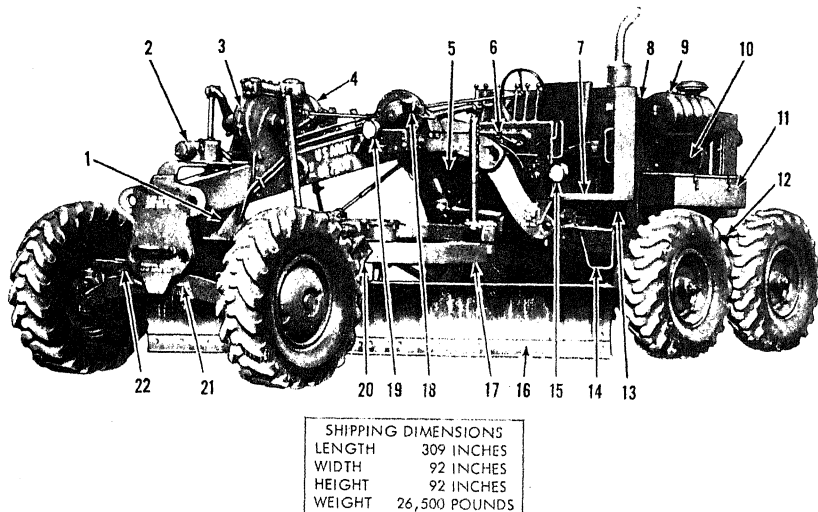
## INTRODUCTION

### Section I. GENERAL

#### 1-1. Scope

a. These instructions are published for use of personnel to whom the motorized road grader (figs. 1-1 and 1-2) is issued. They provide

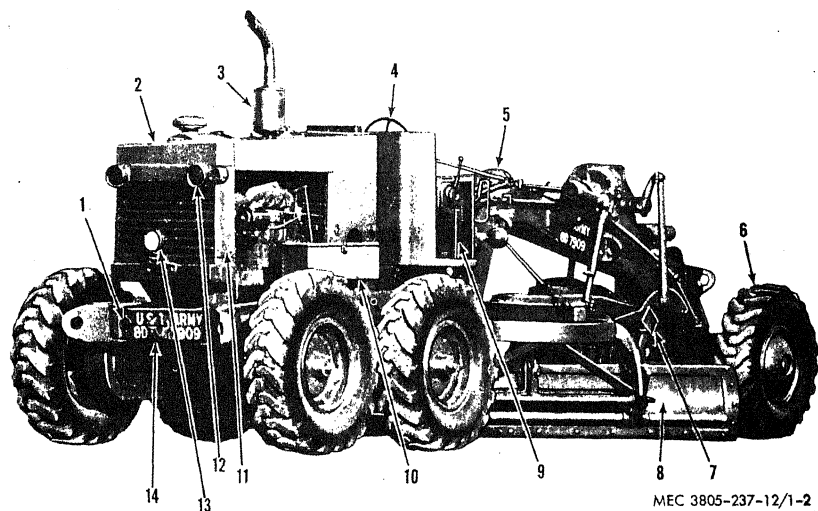
information on the operation and organizational maintenance of the equipment. Also included are descriptions of main units and their functions in relationship to other components.



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- |                      |                       |                          |
|----------------------|-----------------------|--------------------------|
| 1 Main frame         | 9 Air cleaner         | 17 Circle                |
| 2 Steering gear      | 10 Engine             | 18 Blackout headlight    |
| 3 Scarifier housing  | 11 Battery box        | 19 Floodlight            |
| 4 Lift housing       | 12 Tandem drive       | 20 Scarifier block       |
| 5 Lateral housing    | 13 Clutch             | 21 Front axle            |
| 6 Power control box  | 14 Lower transmission | 22 Leaning wheel housing |
| 7 Upper transmission | 15 Headlight          |                          |
| 8 Fuel tank          | 16 Moldboard          |                          |

Figure 1-1. Model 440HA motor grader, left front, three-quarter view with shipping dimensions.



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- |                  |                             |                  |
|------------------|-----------------------------|------------------|
| 1 Reflector      | 6 Front wheel               | 11 Radiator      |
| 2 Engine hood    | 7 Scarifier                 | 12 Taillight     |
| 3 Muffler        | 8 Moldboard                 | 13 Floodlight    |
| 4 Steering wheel | 9 Transmission shift levers | 14 Towing pintle |
| 5 Lift housing   | 10 Tool box                 |                  |

Figure 1-2. Model 440HA motor grader, right rear, three-quarter view.

b. Appendix A contains a list of publications applicable to this manual. Appendix B contains the list of basic issue items authorized the operator of this equipment and the list of maintenance and operating supplies required for initial operation. Appendix C contains the maintenance allocation chart.

c. Numbers in parentheses following nomenclature callouts on illustrations indicate quantity; numbers preceding callouts indicate preferred maintenance sequence.

d. DA Form 2028 (Recommended changes to DA Publications) will be used for reporting discrepancies and recommendations for improving this equipment publication. This form will be completed by the individual using the manual and forwarded direct to Commanding

General, U.S. Army Mobility Equipment Command, ATTN: AMSME-MPD, 4300 Goodfellow Blvd., St. Louis, Mo., 63120.

e. Report all equipment improvement recommendations as prescribed by TM 38-750.

## 1-2. Record and Report Forms

a. DA Form 2258 (Depreservation Guide for Vehicles and Equipment).

b. For other record and report forms applicable to the operator, crew and organizational maintenance, refer to TM 38-750.

*Note.* Applicable forms, excluding Standard Form 46 (United States Government Motor Vehicles Operator's Identification Card) which is carried by the operator, will be kept in a canvas bag mounted on the equipment.



## Section II. DESCRIPTION AND TABULATED DATA

### 1-3. Description

a. *Motor Grader.* The motor grader is a self-propelled grader operated by one man. The model 440HA motor grader moldboard (16, fig. 1-1) is hydraulic operated and can be adjusted to every position relative to the work to be performed.

b. *Engine.* The engine used to power the motor grader is a 2 cycle, naturally aspirated, four cylinder diesel engine. The engine (10, fig. 1-1 is mounted in a housing at the rear of the operator's seat. Drive for the rear wheels is provided through a clutch to the two transmissions and to the driving axles. The engine also drives two hydraulic pumps through the power control box.

c. *Clutch.* Power from the engine crankshaft is connected to the grader drive shaft through a dry-plate clutch. The clutch is controlled by the clutch pedal and clutch brake. The clutch brake will stop clutch rotation three to four seconds after pedal is depressed to make shifting and power operation faster.

### 1-4. Identification and Tabulated Data

a. *Identification.* The motor grader has four major identification plates. The information contained on the plates is listed below.

- (1) *Engine plate.* The engine plate lists the engine model, unit number, rated horsepower, continuous horsepower, and maximum revolutions per minute with no load.
- (2) *Transmission instruction plate.* The transmission instruction plate illustrates the shifting diagram for the upper and lower transmissions and details lever positions for the six forward speeds and three reverse speeds delivered by the transmissions.
- (3) *Grader transportation data plate.* The vehicle transportation data plate illustrates lift and tiedown facilities of the motor grader. This plate also gives moldboard blade and scarifier positions for shipping. Loads on the tandem axle and front axle are also detailed.

(4) *Grader identification plate.* This plate identifies the motor grader by model, serial, and registration numbers, identifies the government contract it was manufactured under, and vehicle weight and dimensions.

#### b. Tabulated Data.

##### (1) Motor grader.

Manufacturer	Westinghouse Air Brake Company Construction Equipment Division
Model	440HA
Type	Self-propelled road grader
Serial numbers	440HAGM001 thru 440HAGM520

##### (2) Engine.

Manufacturer	General Motors
Type	4 cylinder in-line
Model	4057C
Bore	4.250 inches
Stroke	5 inches
Fuel	Diesel
Piston displacement	284 cubic inches
Compression	17 to 1
Main bearing bore (ID)	3.8120 to 3.8130 inches
Number of main bearings	5
Firing order	1-3-4-2
Governed speed	1975 rpm
High idle	2140 rpm

##### (3) Engine accessories.

###### (a) Generator.

Manufacturer	Delco-Remy (1105993)
Part number	MS13823-1
Voltage	24 volts
Amperage	18 amps

###### (b) Starter.

Manufacturer	Delco-Remy
Part number	1113842

###### (c) Air cleaner.

Manufacturer	Donaldson
Part number	MS39247-6

###### (d) Fuel filter.

Manufacturer	AC Spark Plug
Part number	5571256

###### (e) Fuel pump.

Manufacturer	Detroit Diesel
Part number	5184532

###### (f) Fuel strainer.

Manufacturer	AC Spark Plug
Part number	5571218

###### (g) Voltage regulator.

Manufacturer	Delco-Remy
Part number	1118644

#### (h) Transmission.

Manufacturer	Westinghouse Air Brake Company Construction Equipment Division
Type	Mechanical, 6 speed forward, 3 speed reverse
Part number	493566

#### (i) Clutch.

Manufacturer	Rockford
Type	16 inch, dry

#### (4) Capacities.

Fuel tank	52 gallons
Engine crankcase (less filter).	3.5 gallons
Cooling system	15 gallons
Tandem drive	4 gallons
Upper transmission and shifter housing.	3 gallons
Master cylinder	2.5 pints
Lateral shift housing	15.5 pints
Lateral shift reduction housing.	3.5 pints
Lift housing	3 pints
Lift reduction housings	3.5 pints
Circle reverse housing	5 pints
Front lean wheel housing	8 pints
Scarifier lift housing	24.5 pints
Scarifier lift reduction housing.	1.5 pints
Power box housing	7 pints
Power drive housing (with adapter).	7.75 pints
Lower transmission	15.75 gallons
Hydraulic reservoir	32.5 quarts

#### (5) Nut and bolt torque data.

Item	Torque ft-lb
Cylinder head studs	75
Main bearing stud	35-75
Hand hole cover	10-15

#### Standard torques (engine bolts and nuts)

$\frac{1}{4}$ -20	7-9
$\frac{1}{4}$ -28	8-10
5/16-18	13-17
5/16-24	15-19
$\frac{3}{8}$ -16	30-35
$\frac{3}{8}$ -24	35-39
7/16-14	46-50
7/16-20	57-61
$\frac{1}{2}$ -13	71-75
$\frac{1}{2}$ -30	83-93
9/16-12	90-100
9/16-18	107-117
$\frac{5}{8}$ -11	137-147
$\frac{5}{8}$ -18	168-178
$\frac{3}{4}$ -10	240-250
$\frac{3}{4}$ -16	290-300
$\frac{3}{4}$ -9	410-420
$\frac{3}{4}$ -14	475-485
1-8	580-590
1-14	685-695

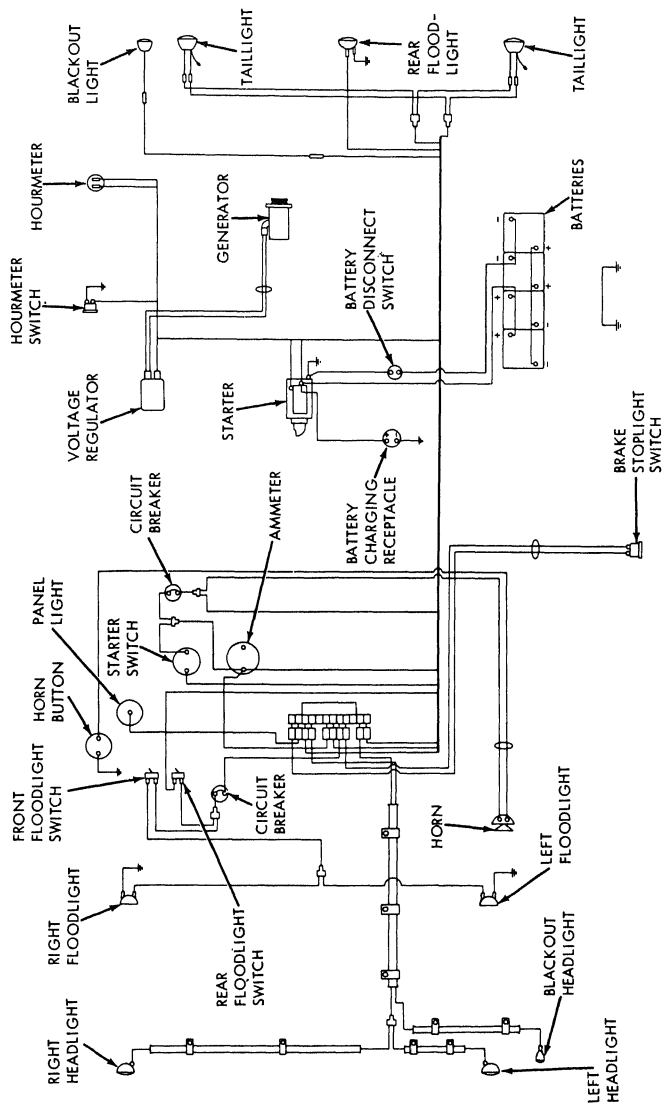
#### (6) Adjustment data.

Exhaust valves	
Valve clearance (cold)	-.012 inch
Valve clearance (hot)	-.009 inch
Valve guide clearance	-.002 inch
Clutch	
Free travel	.2 inches
Clutch spring extension	.13 inches

#### (7) Dimensions and weight (fig. 1-1).

Length	309 inches
Width	92 inches
Height	92 inches
Weight	28,500 pounds

#### (8) Wiring diagram. Refer to figure 1-3 for a schematic wiring diagram of the motor grader electrical circuits.



MEC 3805-237-12/1-3

Figure 1-8. Wiring diagram.



## CHAPTER 2

### INSTALLATION AND OPERATION INSTRUCTIONS

#### Section I. SERVICE UPON RECEIPT OF EQUIPMENT

##### 2-1. Unloading Equipment

a. The motor graders are normally shipped to their destination on railroad cars and are blocked and tied down as shown in figure 2-1.

b. Remove all straps, tiedowns and blocking to free motor grader.

*Caution:* Use care when removing blocking and straps so as not to damage motor grader.

c. The motor grader is equipped with lifting

eyes (fig. 2-1). When an adequate crane is available, lift motor grader from transporter with suitable slings or cables.

d. If a ramp is available to allow removal of the motor grader, the grader can be driven from the transporter. Prepare the motor grader for operation (para 2-3) before attempting to move grader.

*Caution:* Before driving grader from the transporter be sure there is sufficient ground

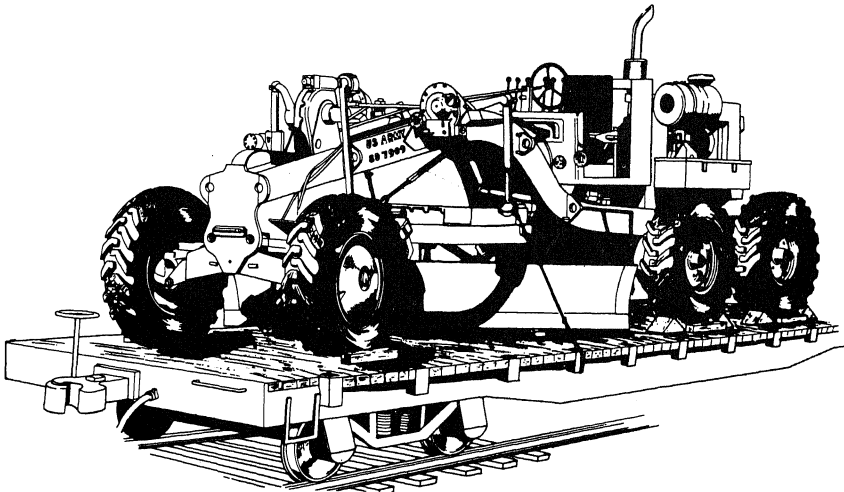


Figure 2-1. Motor grader shipping and unloading details.

clearance when negotiating the ramp.

## 2-2. Unpacking Equipment

The motor grader is shipped assembled with the overpack kit. Check contents of overpack kit for completeness and condition. Remove all protective strapping, tape, and any protective coverings applied to the motor grader.

## 2-3. Inspecting and Servicing Equipment

a. Inspect identification plates on the grader for serial number and other information and compare with data contained on accompanying invoice or packing slip to insure receipt of proper equipment.

b. Inspect entire motor grader for evidence of damage during transit. Inspect the unit for loose connections, broken lines, tightness of attachments and fittings. Check all parts for secure mounting.

c. Perform the daily preventive maintenance services described in paragraph 3-6.

d. Lubricate the motor grader in accordance with current lubrication order and paragraph 3-4.

Note. Engine crankcase is filled with a light break-in oil. Do not operate motor grader under full load until a reasonable engine running time has been accumulated. Drain crankcase and refill with proper oil.

e. Service engine cooling system by closing drain cocks in cylinder block and radiator. Remove radiator filler cap and fill radiator with proper coolant for expected ambient temperature. See table 2-1.

f. If the motor grader is to be put into operation in cold weather (below 20°F), check lubrication chart for proper lubricants and change if necessary. Check coolant in radiator

Table 2-1. Freezing Points, Composition, and Specific Gravities of Military Anti-freeze Materials

Lowest expected ambient temp. °F	Pints of inhibited glycol per gal. of coolant <sup>1</sup>	Compound, anti-freeze arc <sup>1</sup> le <sup>2</sup>	Ethylene glycol coolant solution specific gravity at 68°F <sup>3</sup>
+20	1 ½	Issued full strength and ready mixed for 0 to -65°F temperatures for both initial installation and replenishment of losses.	1.022
+10	2		1.036
0	2 ¾		1.047
-10	3 ¼		1.062
-20	3 ½		1.062
-30	4		1.067
-40	4 ¼		1.073
-50	Arctic anti-freeze preferred		
-60			
-75			
		DO NOT DILUTE WITH WATER OR ANY OTHER SUBSTANCE	

<sup>1</sup>Maximum protection is obtained at 60 percent by volume (4.8 pints of ethylene glycol per gallons of solution).

<sup>2</sup>Military Specification MIL-C-11755 Arctic type, nonvolatile anti-freeze compound is intended for use in the cooling system of liquid-cooled internal combustion engines. It is used for protection against freezing primarily in Arctic regions where the ambient temperature remains for extended periods close to -40°F or drops below, to as low as -90.

<sup>3</sup>Use an accurate hydrometer. To test hydrometer, use 1 part ethylene glycol anti-freeze to 2 parts water. This should produce a hydrometer reading of 0°F.

Note. Fasten tag near radiator filler cap indicating the type anti-freeze.

and replace with anti-freeze to protect cooling system. Refer to table 2-1 for Military anti-freeze materials.

g. Batteries are shipped dry. Fill batteries with electrolyte solution.

## 2-4. Installation of Separately Packed Components

The unit is shipped completely assembled and is ready to operate after services listed in paragraph 2-3 have been performed. No installation of separately packed components is required.

## **2-5. Installation or Setting up Instructions**

No installation or setting up instructions are required to prepare the motor grader for operation.

## **2-6. Equipment Conversion**

Various operations of the motor grader can

be performed without any conversion of the equipment. All necessary details are included in the operation section of this chapter. The only modification that may be required is adjustment of scarifier teeth and is considered a normal operating function.

# **Section II. MOVEMENT TO A NEW WORKSITE**

## **2-7. Dismantling for Movement**

a. The motor grader does not require dismantling before moving to a new worksite.

b. Movement of the motor grader to a new worksite can normally be accomplished by moving the motor grader over the road under its own power. Care should be observed to provide clearance for other traffic when traveling on public roads. The motor grader is wider than normal vehicles and the moldboard should be placed in line with the frame as much as possible to avoid extension to either side and increasing width of grader.

c. Long distance moving of the grader should be accomplished with transportation equipment of a suitable type. Flat bed truck-drawn trailers or railroad flat cars are the most suitable. Depending upon length of journey and type of terrain to be traversed, tiedown and block motor grader securely. See figure 2-1.

## **2-8. Reinstallation after Movement**

No reinstallation after movement is required. Depending on length and type of movement, inspect and service motor grader as detailed in paragraph 2-3 if necessary.

# **Section III. CONTROLS AND INSTRUMENTS**

## **2-9. General**

This section describes, locates, illustrates and furnishes operator, crew, or organizational maintenance personnel sufficient information about various controls and instruments for

proper operation of the motor grader.

## **2-10. Controls and Instruments**

The purpose of controls and instruments and their normal and maximum reading are illustrated in figure 2-2.

# **Section IV. OPERATION OF EQUIPMENT**

## **2-11. General**

a. Instructions in this section are published for information and guidance of personnel responsible for operation of the motor grader.

b. The operator must know how to perform every operation of which the motor grader is capable. This section gives instructions on starting and stopping the motor grader, basic motions of the motor grader, and coordinating basic motions to perform specific tasks for which the equipment is designed. Since nearly every job presents a different problem, the operator may have to vary given procedures to fit the individual job.

(1) Perform necessary daily preventive maintenance services (para 3-6):

(2) Turn handle of battery disconnect switch (fig. 2-2) clockwise and push handle in to connect batteries.

b. *Starting.* Refer to figure 2-3 and start the motor grader.

## **2-13. Stopping**

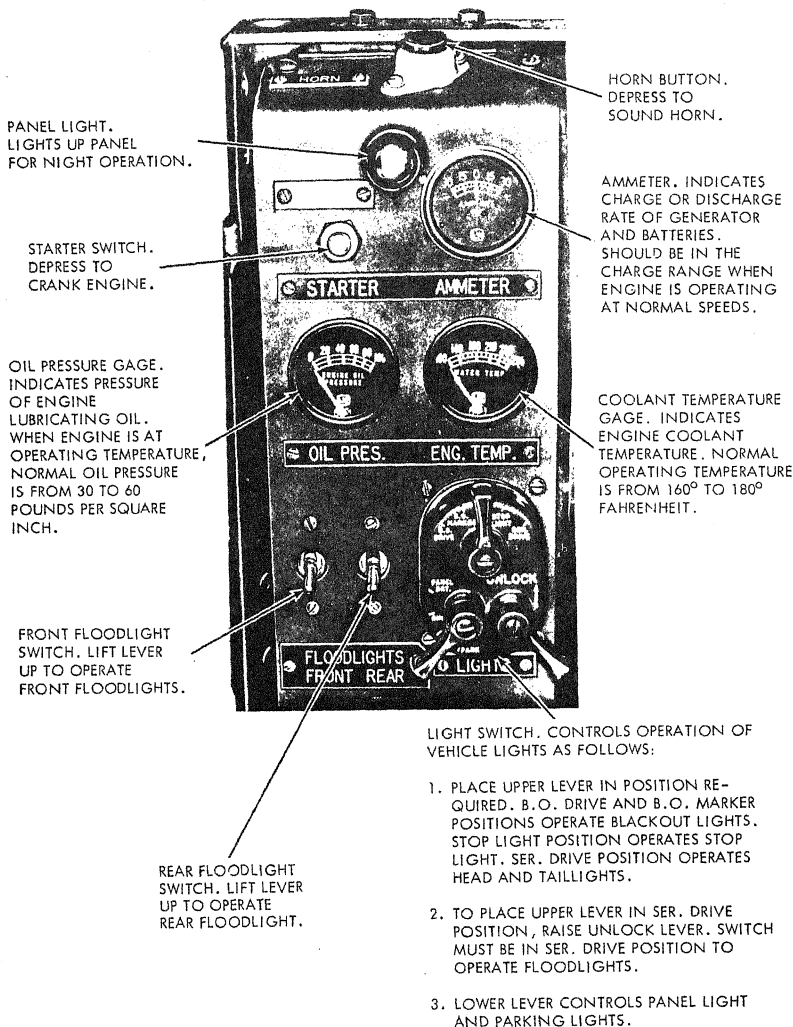
a. Center moldboard under grader and lower to ground.

b. Refer to figure 2-4 and stop the motor grader.

c. Perform the necessary daily preventive maintenance services.

## **2-12. Starting**

a. *Preparation for Starting.*

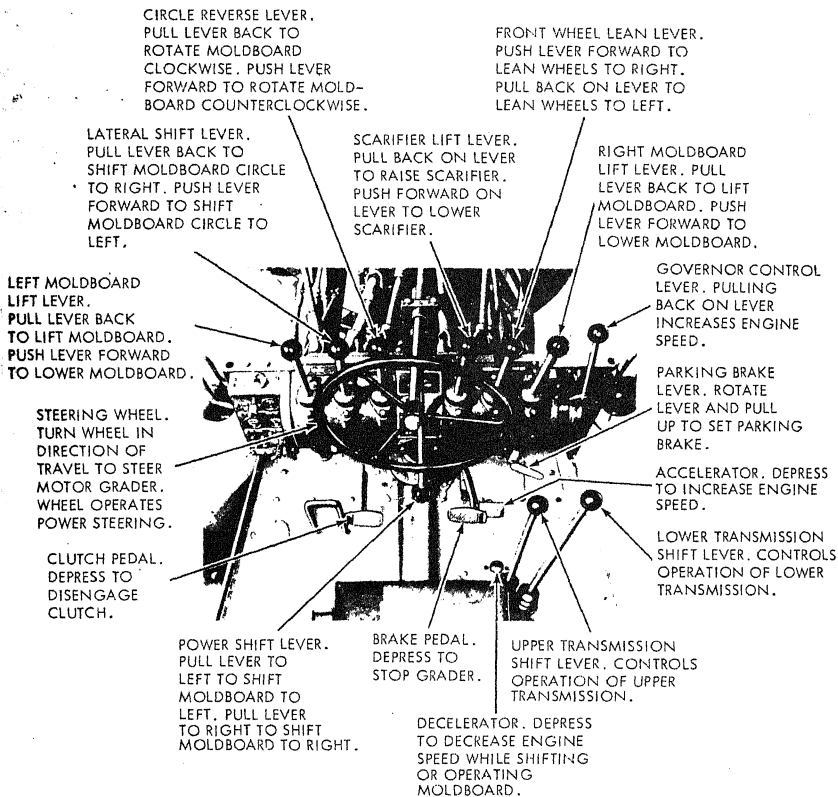


A. INSTRUMENT PANEL

MEC 3805-237-12-2 ①

Figure 2-2 ①. Controls and instruments.





B. OPERATOR'S CONTROLS

MEC 3805-237-12/2-2 ②

Figure 2-2 ②.—continued.

## 2-14. Operation under Usual Conditions

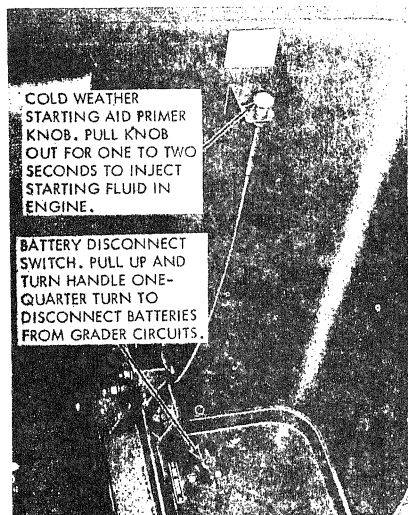
a. *Start Motor Grader.* Refer to paragraph 2-12 and start motor grader.

b. *Placing Grader in Motion.*

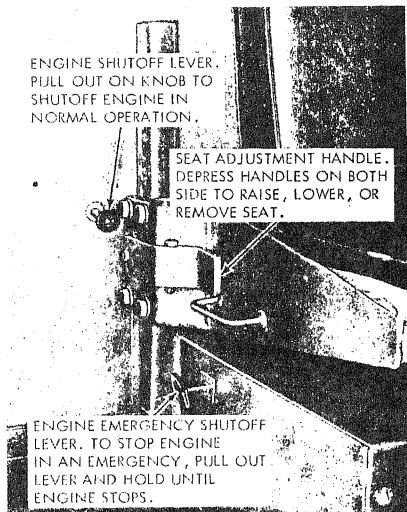
- (1) With engine running at operating temperature depress the clutch pedal (fig. 2-5).
- (2) Release parking brake lever (fig.

2-5).

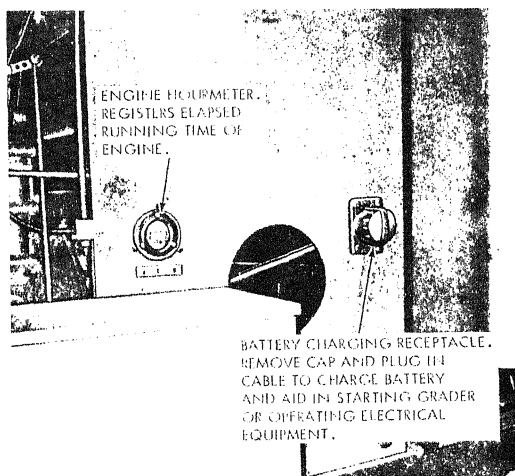
- (3) Place governor control lever at  $\frac{1}{4}$  throttle and move transmission shifter levers (fig. 2-5) in position to provide power requirements for the work to be performed. Refer to figure 2-6 and table 2-2 for suggested transmission speeds.



C. STARTING CONTROLS.

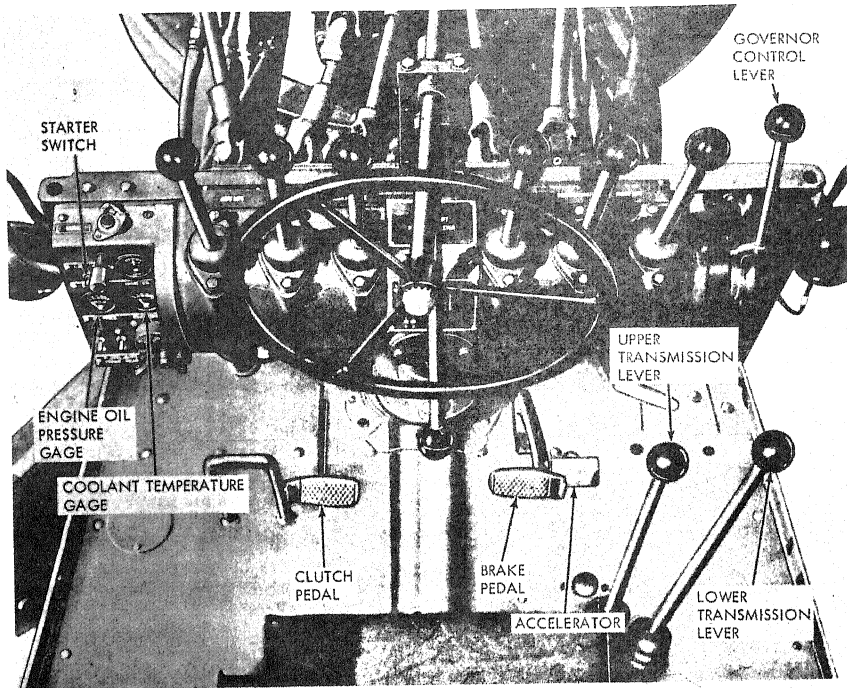


D. ENGINE SHUTOFF CONTROLS.



E. HOURMETER.

MEC 3805-237-12/2-2③



- STEP 1. PLACE ALL CONTROL AND TRANSMISSION LEVERS IN NEUTRAL POSITION.  
 STEP 2. PLACE GOVERNOR CONTROL LEVER AT APPROXIMATELY 1/4 THROTTLE.  
 STEP 3. DEPRESS CLUTCH PEDAL.  
 STEP 4. PRESS STARTER SWITCH UNTIL ENGINE STARTS.

**CAUTION:** DO NOT CRANK ENGINE MORE THAN 30 SECONDS CONTINUOUSLY WITHOUT ALLOWING A TWO MINUTE COOLING OFF PERIOD. IF ENGINE DOES NOT START AFTER A FEW TRIES, STOP CRANKING AND DETERMINE CAUSE. CORRECT OR REPORT CONDITION TO ORGANIZATIONAL MAINTENANCE.

- STEP 5. AFTER ENGINE STARTS, CHECK ENGINE OIL PRESSURE. NORMAL PRESSURE (30 TO 60 PSI) SHOULD BE INDICATED.  
 STEP 6. RELEASE CLUTCH PEDAL.  
 STEP 7. PUSH GOVERNOR CONTROL LEVER IN TO IDLE POSITION.  
 STEP 8. ALLOW ENGINE TO WARM UP AT APPROXIMATELY IDLE SPEED. OPERATING TEMPERATURE RANGE IS 160° TO 180° F.

MEC 3805-237-12/2-3

Figure 2-3. Starting the motor grader.

Table 2-2. Transmission Lever Positions

Work	Upper transmission lever position	Lower transmission lever position	Forward speed	Miles per hour
Bank sloping	L	1	1st	2.2
Clearing	L	1	1st	2.2
Ditching	L	1	1st	2.2
Leveling	L	1	1st	3.2
Scarifying	L	1	1st	2.2
Inslope finishing	L	1	1st	2.2
Snow plowing	L	2	3rd	4.4
Terracing	H	1	2nd	3.2
Spreading	H	1	2nd	3.2
Finish	L	1	1st	2.2
Light dozing	H	1	2nd	3.2
Highway travel	H	3	6th	22.5
Shoulder grading	H	1	2nd	3.2
Surface grading	H	1	2nd	3.2
Side filling	H	1	2nd	3.2

*Note.* Speeds and gear ranges shown in table are suggested and are at the discretion of the operator in the interests of safety and the power requirements of the job.

*Note.* The upper transmission lever controls high (H) and low (L) ranges and reverse gear (R).

- (4) Slowly release clutch pedal until grader begins to move. Continue to release clutch pedal while simultaneously depressing accelerator (fig. 2-5) or pulling back on governor control lever to increase engine speed.

*Note.* Avoid spinning the tandem tires when starting out. Spinning damages road surfaces and causes excessive tire wear.

- (5) With clutch pedal fully released, control speed of grader with governor control lever or accelerator.

#### c. Shifting Transmission While in Motion.

*Note.* Always start motor grader in transmission speed that will permit completion of work or cut without requiring further shifting.

- (1) Depress clutch pedal and depress decelerator pedal (fig. 2-5) to decrease engine speed. Do not depress clutch pedal all the way to avoid setting clutch brake.

**Caution:** If changing direction of travel, bring grader to a complete stop before shifting.

- (2) Shift transmission shifter levers as required to provide correct transmission speed.
- (3) Release clutch pedal smoothly and increase engine speed to maintain momentum.

d. *Steering.* Steer the motor grader with the steering wheel (fig. 2-5). Movement of the steering wheel operates the power steering system. A hydraulic cylinder assists in moving the front wheels in the direction of the turn. Turn wheel in opposite direction to center wheels after completion of turn. Front wheels also have a leaning feature to prevent drifting or side-skidding of front wheels due to the force of the load on the moldboard.

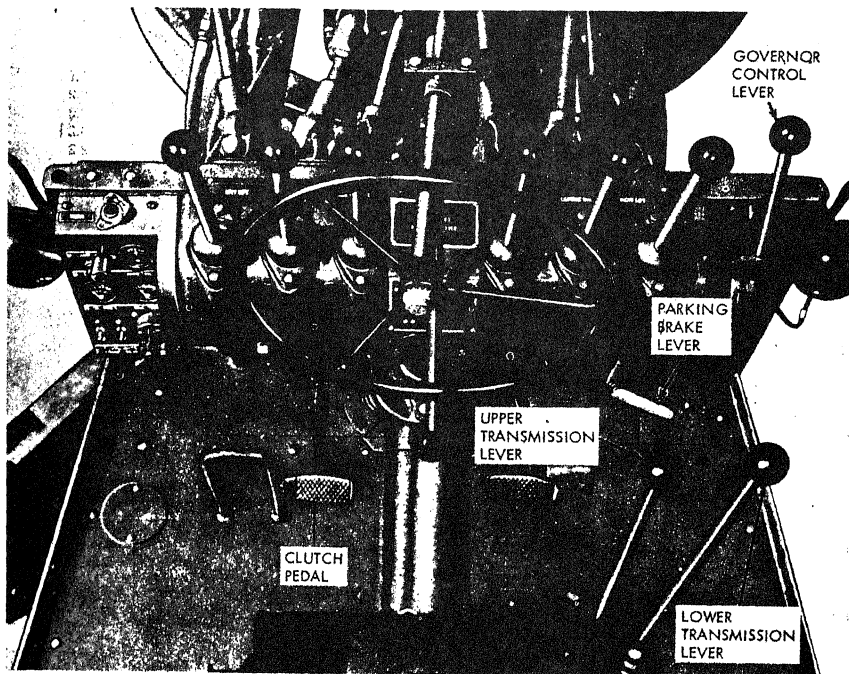
e. *Moldboard Operation.* The basic function of the motor grader is grading with the moldboard. Many types of grading can be accomplished. The moldboard is power operated and can be positioned to perform all grading operations.

*Note.* Before placing machine into operation, engine must be running at operating temperature (para 2-12).

- (1) *Raising moldboard.* Pull back on lift control levers (fig. 2-7) to raise moldboard.

*Note.* Remove scarifier teeth when not using scarifier to keep them from filling with dirt and debris.

- (2) *Lowering moldboard.* Push forward on lift control levers on lower moldboard.
- (3) *Lateral shift of moldboard.* The moldboard can be shifted laterally to either side by moving the lateral shift lever



- STEP 1. DEPRESS CLUTCH PEDAL.
- STEP 2. PLACE ALL CONTROL AND TRANSMISSION LEVERS IN NEUTRAL POSITION.
- STEP 3. RELEASE CLUTCH PEDAL.
- STEP 4. SET PARKING BRAKE.
- STEP 5. PLACE GOVERNOR CONTROL LEVER IN IDLE POSITION.
- STEP 6. ALLOW ENGINE TO OPERATE AT IDLE SPEED FOR 4 OR 5 MINUTES.
- STEP 7. PULL OUT ON ENGINE SHUTOFF LEVER (FIG. 2-2) AND HOLD OUT UNTIL ENGINE STOPS.

MEC 3805-237-12/2-4

*Figure 2-4. Stopping the motor grader.*

(fig. 2-7). To move the moldboard to the right, pull back on the lever. Pushing forward on the lever will move the moldboard to the left. In shifting the moldboard laterally in this manner the entire circle is shifted.

- (4) *Shifting moldboard.* The moldboard can be shifted laterally as above with the lateral shift levers. Model 440HA motor graders are equipped with a power shift moldboard which permits lateral shifting of moldboard either to

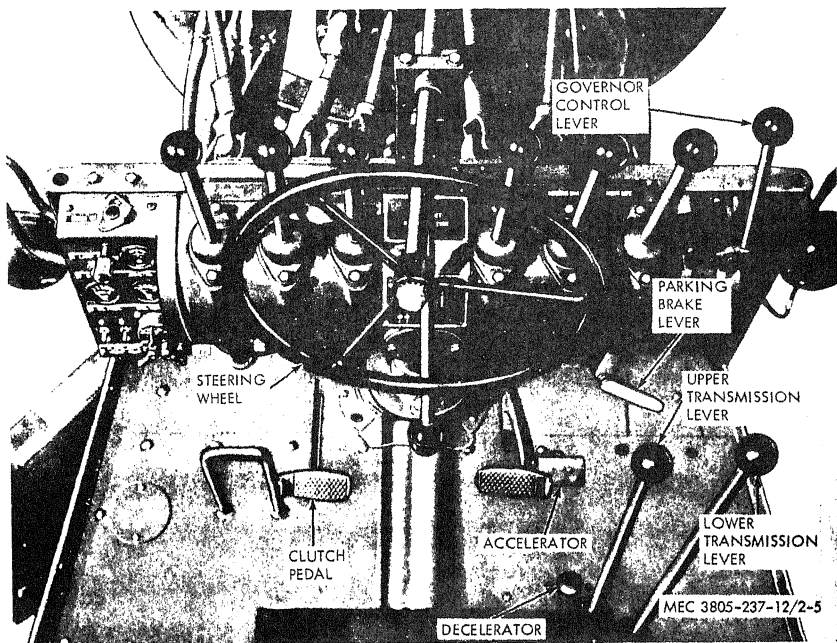


Figure 2-5. Placing grader in motion.

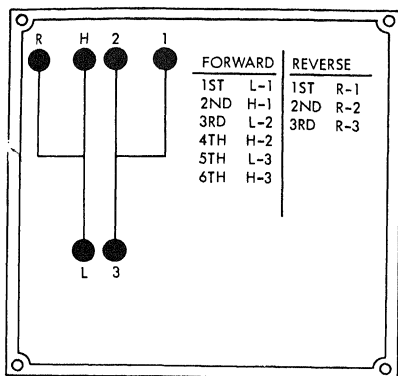
the right or left without shifting the circle. The power shift moldboard is controlled by the power shift lever (fig. 2-7). Moving power shift lever to the left will move moldboard to the left. Moving lever to the right will shift moldboard to the right.

- (5) *Angling moldboard.* To provide for delivery of material either to the right or left of machine while grading moldboard is to be rotated until desired angle has been obtained. For delivery of material to left of grader, pull back on circle reverse lever (fig. 2-7). To angle moldboard in opposite direction for delivery of material to right of

grader, push circle reverse lever forward.

f. *Moldboard Link Adjustments.* In addition to the moldboard movements listed above, range of the movements can be supplemented by moving the link adjustments.

- (1) *Lift link adjustment.* The right and left hand lift links (fig. 2-8) have five adjustments to provide greater or less height to moldboard lift. To adjust links, loosen clamp bolts (A). Lower moldboard to ground to take weight off locking pins (B). Remove cotter pins and remove locking pins. Operate left control levers to raise or lower lift link tubes to desired position. In-



MEC 3805-237-12/2-6

Figure 2-6. Transmission shifting diagram.

stall locking pin through holes and secure with cotter pin. Tighten clamp bolts.

*Note.* Both lift links must be adjusted. For normal operation, locking pin should be in hole 3 or 4 (fig. 2-8) in right hand link and in hole 3 in left hand link.

- (2) *Lateral link adjustment.* The lateral link adjustment (fig. 2-9) allows the operator to fully extend the moldboard to either side or to shorten the lateral shift of the moldboard. To adjust lateral link, remove cotter pin and locking pin. Shift moldboard, using lateral shift lever (fig. 2-7) to slide adjusting link to desired position. Install locking pin in proper hole and secure with cotter pin.

*Note.* Figure 2-9 illustrates the lateral link connected to the left side of the circle drawbar. When moldboard operation is to be on the right side of the grader the lateral link should be in this position. If moldboard operation is to be on the left side of the grader, disconnect link from ball on drawbar by loosening bolts holding cap to ball and connect link to ball on right side of circle drawbar. Tighten screws securely.

*g. Pitching Moldboard.* As grader moves and material slides along moldboard, moldboard

must be pitched properly for correct discharge of material. To adjust moldboard pitch proceed as follows.

- (1) Lower moldboard to the ground, with moldboard at right angles to wheels.
- (2) Remove cotter pins from pivot bolts (fig. 2-10) on plates at both ends of moldboard.
- (3) Loosen nuts on locking plates (fig. 2-10) until locking plate is free of notches.
- (4) Move motor grader forward or backward until desired pitch of moldboard is obtained.
- (5) Install lock plates in notches and tighten nuts. Tighten pivot bolt nuts and secure with cotter pins.

*h. Grading.* Normal grader operation consists of spreading, finishing, or bulldozing with the moldboard. To perform the grading operation proceed as follows:

- (1) Start grader engine (para 2-12).
- (2) Position scarifier block, using scarifier lever (fig. 2-7), to provide clearance between scarifier block and circle drawbar during operation.
- (3) Adjust front wheels to a vertical position by moving front wheel lean lever (fig. 2-7) as necessary.
- (4) Lower moldboard with moldboard lift levers (fig. 2-7).
- (5) Angle moldboard, using circle reverse lever (fig. 2-7), to proper angle.

*Note.* Moldboard must be positioned to discharge dirt either inside or outside of rear wheels. Cut cannot be kept straight if wheels run over discharged dirt.

- (6) To properly position moldboard during various operations, it may be necessary to operate moldboard lift levers, circle reverse lever, and lateral shift lever in sequence or simultaneously. All levers aid in positioning the moldboard to extent desired, the lateral link may have to be adjusted (Para f above). The power shift lever may be utilized to extend the moldboard.
- (7) With moldboard positioned, place grader in motion (b above). As grader moves forward, check grader for side

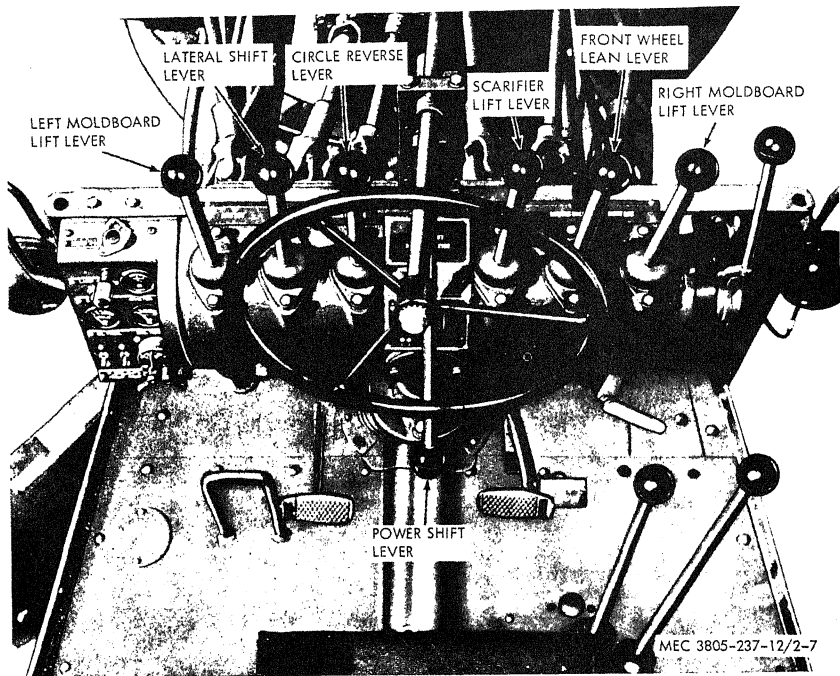


Figure 2-7. Moldboard operation levers.

thrust caused by load on moldboard.

- (8) If grader is shifting to the side, lean front wheels in opposite direction, using front wheel lean lever (fig. 2-7) to offset side thrust of blade and keep grader in straight line.
- (9) Raise or lower moldboard as necessary to accomplish amount of grading necessary to produce result desired.

*i. Ditching.* The motor grader can be used to form flat bottom ditches by operating in a series of steps as described below.

- (1) To maintain a straight ditch, set a line of stakes to follow before making first cut.

- (2) Set moldboard as described above, with point of moldboard positioned directly behind front wheel (fig. 2-11).
- (3) As motor grader moves forward, point of moldboard blade is pushed into ground. Point is positioned directly behind front wheel to hold proper alignment. In succeeding cuts (fig. 2-12) front and rear wheels should track in previous cut.
- (4) Lean front wheels slightly away from ditch to overcome side thrust.
- (5) At completion of first cut (fig. 2-12), position motor grader as shown in sec-



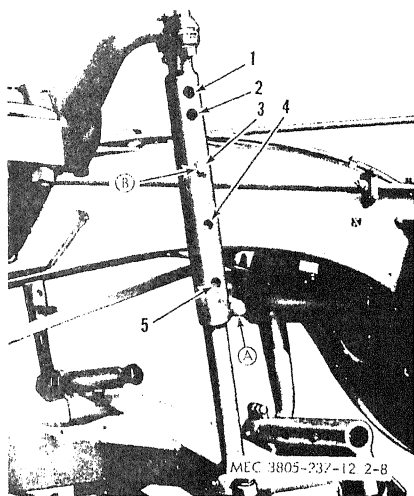


Figure 2-8. Lift link adjustment.

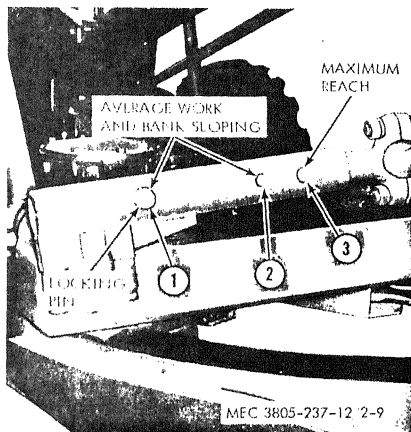


Figure 2-9. Lateral link adjustment.

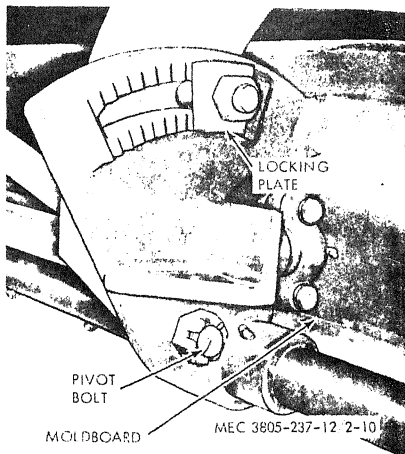


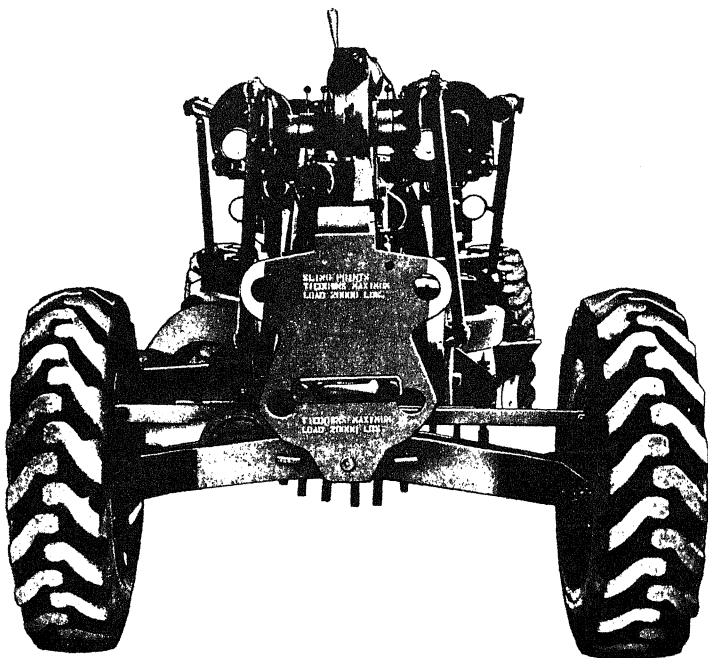
Figure 2-10. Pitching moldboard.

and operation. Point of moldboard should be approximately 1 foot away from first cut, with wheels on cutting side of grader riding in first cut and wheels on opposite side on top of ground (fig. 2-12).

- (6) For third cut, position grader as shown in third operation (fig. 2-12) and complete cut.
- (7) To finish ditch, shift moldboard to position it outside of wheel as shown in fourth operation (fig. 2-12) and clean bottom of ditch. Last illustration (fig. 2-12) shows finished ditch.

j. *Bank Sloping.* The moldboard, through use of lateral shift lever, lift levers, circle reverse lever, and changing lateral link and lift link adjustments, can be set at any desired position for bank sloping. Bank sloping is accomplished by swinging and raising the moldboard to the side of the grader at the angle of the desired slope and moving the grader along the slope with the moldboard cutting at the desired depth.

- (1) Figure 2-13 illustrates moldboard and link settings for right hand bank sloping.



MEC 3805-237-12/2-11

Figure 2-11. Preparing to start ditch cut.

- (2) When bank sloping, operate front wheel lean lever (fig. 2-7) to lean wheels toward bank to counteract side shift of motor grader.

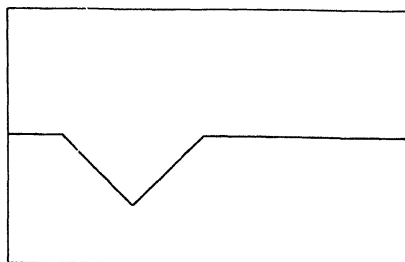
*Note.* When bank sloping at a 90° angle as shown in figure 2-13, heel of moldboard blade must extend beyond wheels.

- (3) To prepare for bank sloping on left side of motor grader reverse position of lift link pins and position of lateral link.

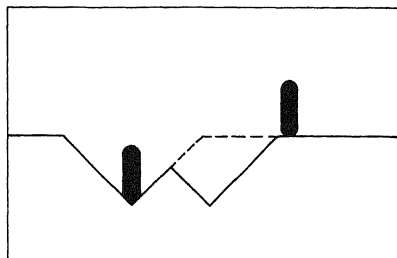
#### k. Scarifier Operation.

- (1) A scarifier is used to rip material

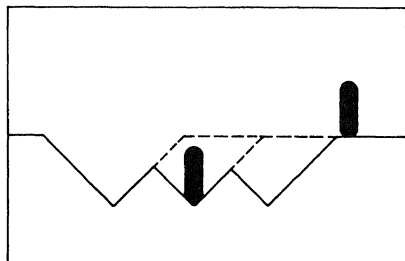
which is too hard to cut with the moldboard. To reshape the surface of a gravel or stone road or runway, lower scarifier block until teeth penetrate far enough to get below bottom of chuck holes. If greater penetration is desired, teeth can be lowered by repositioning shanks in block or lowering scarifier lift link tubes. When operating in extremely hard materials it is recommended that scarifier teeth be positioned up into block as far as adjustment permits.



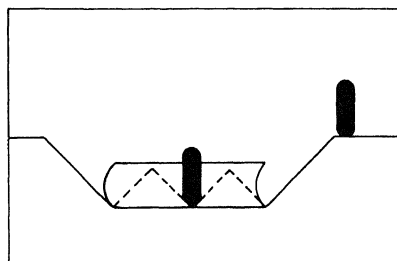
A. FIRST OPERATION



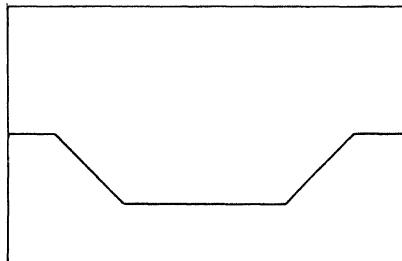
B. SECOND OPERATION



C. THIRD OPERATION



D. FOURTH OPERATION



E. FLAT BOTTOM DITCH

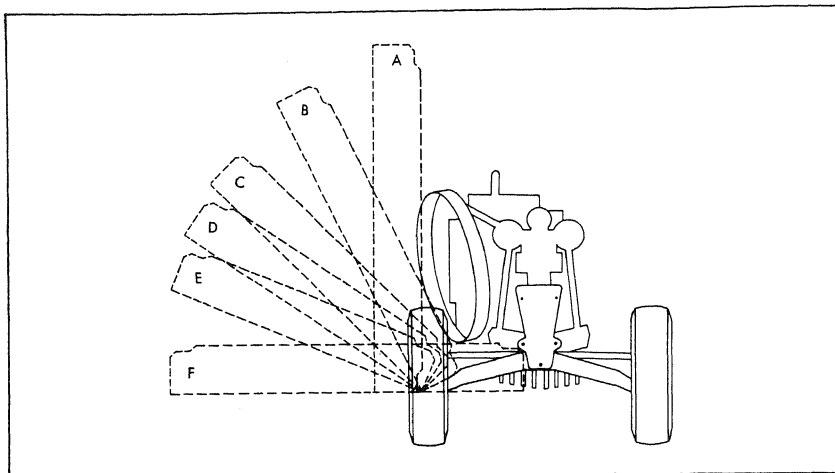
MEC 3805-237-12/2-12

Figure 2-12. Ditching operation.

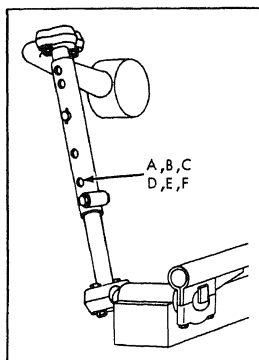
Note. During scarifier operation, block must be parallel with ground.

- (2) If scarifier is to be used to break up a crusted or asphalt surface, teeth must be lowered and pitched at such a

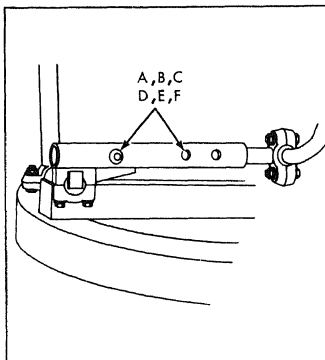
degree to permit penetration beneath hard surface and result in a lifting action as machine is moved forward. This will result in breaking up material to permit its removal.



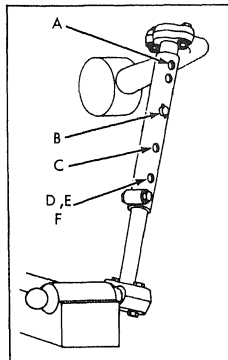
A. MOLDBOARD POSITIONS FOR BANKSLOPING



B. LEFT HAND LINK



C. LATERAL LINK



D. RIGHT HAND LINK

MEC 3805-237-12/2-13

Figure 2-13. Moldboard and link positions for bank sloping.

- (3) At end of scarifying operation, raise scarifier and remove scarifier shanks and teeth (fig. 2-14). Store teeth and shanks in tool box.
- (4) Position scarifier block in such a manner to assure there will be no interference with circle drawbar during moldboard operations.

#### l. Installing scarifier teeth and shanks.

- (1) Insert shank up through slot in bottom of scarifier block and secure with key (fig. 2-14).
- (2) Desired extension of tooth and shank is determined by positioning of notches in shank opposite upper plate of block.

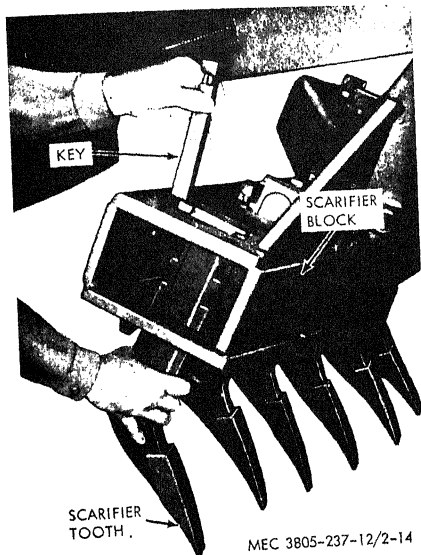


Figure 2-14. Installation or removal of scarifier shank and tooth.

#### m. Removal of scarifier teeth and shanks.

- (1) Push forward on lower portion of tooth shank to permit removal of key.
- (2) Lower shank until it clears block.
- (3) If removal of tooth only is desired, place end of tool (fig. 3-1) against top of tooth body and strike with hammer until tooth drops from shank.

Note. Scarifier teeth must be kept sharp to obtain best results during operation.

#### n. Adjusting pitch of scarifier.

- (1) Pitch of scarifier determines the amount of tooth penetration. Three (3) adjustments may be made at the scarifier block and two (2) on the scarifier lift link tubes.

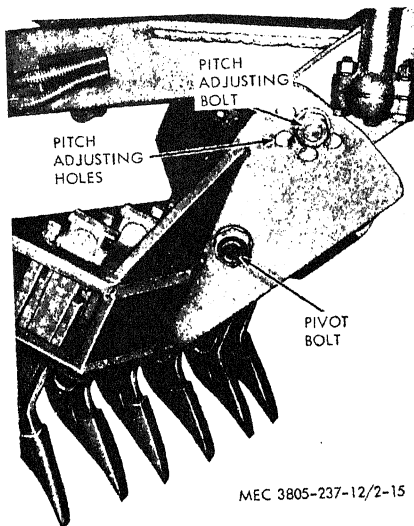


Figure 2-15. Adjusting pitch of scarifier.

- (2) To adjust at block, first lower scarifier to ground. Remove pitch adjusting bolt (fig. 2-15). Raise or lower scarifier lift links by using control lever (fig. 2-7) until block is positioned at desired pitch. Install bolt, nut and cotter key.
- (3) To adjust at lift link tubes, first lower scarifier to ground. Remove cotter pins from locking pins at upper end of tubes and drive out pins. Raise or lower tubes depending on desired position of scarifier using scarifier control lever, until pin hole in tube is aligned with that in lift link. Install locking pin and cotter pin.

#### *o. Parking the Grader.*

- (1) Move motor grader to parking position.
- (2) Depress clutch pedal and move transmission levers to neutral position.
- (3) Depress brake pedal and bring motor grader to a stop.
- (4) Engage parking brake.
- (5) Refer to paragraph 2-13 (fig. 2-4) and stop motor grader engine.

### **2-15. Operation in Extreme Cold (Below 0° F)**

*a. General.* If the motor grader is to be operated in extreme cold weather temperatures, certain precautions must be taken to assure continued normal operations. The following paragraphs detail checks to be made to be certain the grader is capable of operating at these temperatures.

*b. Cooling System.* Check cooling system for correct antifreeze solution for lowest temperature expected (table 2-1). Carefully inspect cooling system and correct or report any leaks.

*c. Batteries.* Keep batteries fully charged to prevent freezing. If water is added to batteries, run engine for at least one hour to mix electrolyte solution.

*d. Fuel System.* Keep fuel tank full at all times. Drain condensate from fuel tank before and after operation. Drain and service fuel filters (par 3-4).

*e. Lubrication.* Lubricate entire motor grader according to the current lubrication order.

*f. Operation.* Start engine and allow it to reach normal operating temperature before applying load.

- (1) Operate hydraulic units with care until units have reached a temperature to enable them to operate normally.
- (2) Check all moldboard and grader operations with operating levers to be sure they are in operating condition.

#### *g. Parking.*

- (1) Park grader on high dry ground if possible. Prepare a footing of planks or brush if necessary to keep grader wheels from freezing in ground. Chock wheels and release parking brake.

Place blocks under moldboard to prevent blade from freezing to ground.

- (2) Clean all mud, snow, and ice from grader to prevent freezing. Park grader under cover or cover with a tarpaulin if possible. Keep ends of tarpaulin from freezing to ground.

### **2-16. Operation in Extreme Heat**

*a. General.* Continuous heavy operation of the motor grader in high temperatures may cause the grader to overheat. Avoid continuous low gear operation if possible. Continuously observe engine temperature and halt grader for a cooling-off period whenever necessary.

*b. Cooling System.* Make frequent inspections and servicings of the fan and radiator. Keep coolant level to top of radiator. Check grilles and radiator fins for accumulation of dust, sand, and insects which could block cooling passages.

- (1) Formation of scale and rust in cooling system occurs more rapidly in extremely high temperatures. Change anti-freeze each year to keep corrosion inhibitor at full strength.
- (2) If necessary, flush cooling system periodically to keep passages clear. Avoid use of water with a high alkali content which increases scale and rust formations.

*c. Batteries.* Check level of electrolyte daily. Keep electrolyte above plates to prevent damage to batteries. Use a slightly weaker electrolyte in hot climates. Dilute 1.280 specific gravity electrolyte as issued to 1.200 to 1.240 specific gravity reading at full charge. Recharge batteries at 1.160 specific gravity. Batteries self-discharge at a higher rate if left standing for long periods at high temperatures. If grader is to stand for several days, remove batteries and store in a cool place.

**Caution:** Do not store acid-type storage batteries near stacks of tires; the acid fumes have a harmful effect on rubber.

*d. Fuel System.* Service fuel system as directed in the preventive maintenance (paras 3-6 and 3-7). Check fuel for water content before filling tank. High temperatures and cooling off cause condensation in drums.

e. *Lubrication.* Lubricate as specified in current lubrication order (para 3-2).

f. *Parking.*

- (1) Do not park grader in sun for long periods of time. When practical park grader under cover to protect it from sun, sand and dust.
- (2) Cover inactive grader with tarpaulins if no suitable shelter is available. Protect power plant compartment against entry of sand.
- (3) In hot, damp climates, corrosive action will occur on all parts of the grader and will be accelerated during the rainy season. Rust and paint blisters will appear on metal surfaces and fungus growth on other surfaces.
- (4) Protect all unfinished exposed metal surfaces with a film of preservative lubricating oil, medium (P10). Protect cables and terminals with ignition-insulation compound. Apply paint or suitable rust preventive to damaged surfaces to protect from rust and corrosion.

## 2-17. Operation in Dusty or Sandy Areas

a. *General.* Operation of the grader will cause dust in almost any area. However, when operating in predominantly dusty or sandy areas additional precautions must be taken.

b. *Cooling System.* Keep cooling system radiator fins and cooling areas clean. Blow out with compressed air, if possible, as often as necessary.

c. *Fuel System.* Use care when servicing fuel system to prevent dust sand from entering tank or filters.

d. *Air System.* Service air cleaner at frequent intervals, checking it every few hours and keeping dust cup clean. Avoid allowing dust and sand to get into engine parts as much as possible.

e. *Lubrication.* Lubricate grader according to current lubrication order (fig. 3-2). Clean all lubrication fittings thoroughly before applying lubricant. Sand mixed with lubricant becomes very abrasive and speeds wear on parts, there-

fore, lubricate and perform services at much shorter intervals than normal.

f. *Parking.* Protect grader from dust and sand as much as possible. Park grader under cover or protect with tarpaulins to keep dust and sand from damaging vehicle.

## 2-18. Operation under Rainy or Humid Conditions

a. *General.* Operation under rainy or humid conditions is similar to that in extreme heat.

b. *Preservation.* Keep all exposed surfaces coated with preservative lubricating oil (PT medium). Pay particular attention to damaged painted surfaces. Cover all paint cracks and chip marks as soon as possible to avoid corrosive effects.

## 2-19. Operation in Salt Water Areas

a. *General.* The corrosive effect of salt water and salt water spray is very extensive. When operating in salt water areas observe the following precautions.

b. *Preservation.*

- (1) When exposed to salt water, dry grader thoroughly and rinse as soon as possible.
- (2) Keep all exposed surfaces coated with preservative lubricating oil (PT medium).
- (3) Keep all painted surfaces in good repair.
- (4) Lubricate vehicle as prescribed in current lubrication order (fig. 3-2). Shorten lubricating intervals for parts subject to exposure to salt water.

## 2-20. Operation at High Altitudes

a. Normally, operation of the motor grader at high altitudes will be as outlined in paragraph 2-15, operation in extreme cold.

b. Check engine operating temperature to insure against overheating. The pressure cap on the radiator must make a perfect seal to maintain radiator pressure.

c. The operating efficiency of the grader engine should not be affected. A blower assembly on the engine maintains a sufficient supply of air for the cylinders.

## Section V. OPERATION OF AUXILIARY MATERIEL USED IN CONJUNCTION WITH THE EQUIPMENT

### 2-21. General

a. This section contains detailed instructions on the operation of auxiliary equipment issued with the motor grader.

b. An ether cartridge type cold weather starting aid is supplied to aid in starting the grader engine in cold weather.

### 2-22. Cold Weather Starting Aid

a. *General.* The cold weather starting aid used on the grader is of the ether primer type.

Highly volatile fuel (ether) is injected into the air intake system to assist in igniting fuel at low temperatures. The fluid is contained in capsules. The starting aid (fig. 2-16) is mounted on the rear wall of the engine compartment, with the primer knob (fig. 2-2) mounted on the left side of the operator's compartment. Tubing connects the starting aid to the air intake on the engine.

#### b. Operation.

- (1) Remove cap (fig. 2-16) and install container in top of valve. Secure container with latch.
- (2) Set governor control lever to  $\frac{1}{2}$ — $\frac{3}{4}$  speed. Pull out on primer knob (fig. 2-2) mounted in cab and hold out for 1 to 2 seconds (with engine turning over). Push knob in to inject fluid into air intake.

*Caution:* Do not pull primer knob until cranking action starts. Serious damage to the engine could result.

- (3) If engine fails to start, wait 1 second and repeat step (2).
- (4) When engine starts be sure primer is pushed all the way down.

#### c. Precautions.

- (1) Use starting aid only for starting engine in cold weather.
- (2) When motor grader is to be used only in warm climates where starting aid may not be required, remove container (fig. 2-16) from valve and install cap (fig. 2-16) on valve.

*Caution:* The above action will prevent inadvertent injection of the highly volatile fluid into the air intake and resulting damage to the engine when started.

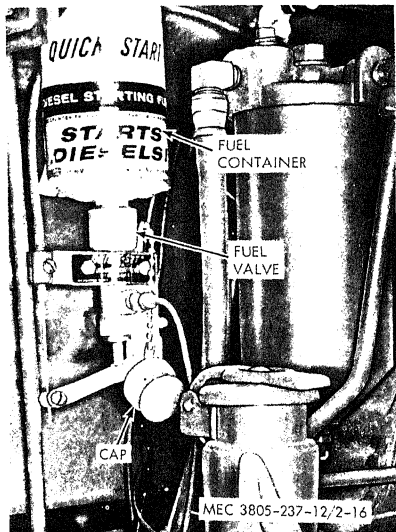


Figure 2-16. Cold weather starting aid.



## CHAPTER 3

# OPERATOR AND ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

### Section I. OPERATOR AND ORGANIZATIONAL MAINTENANCE TOOLS AND EQUIPMENT

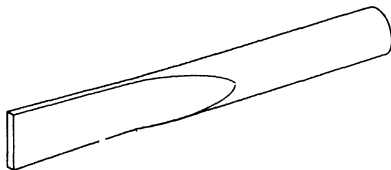
#### 3-1. Special Tools and Equipment

Table 3-1 lists the special tools applicable to

operator and organizational maintenance of the motor grader.

Table 3-1. Special Tools

Item	FSN or Part No.	Reference		Use
		Figure	Paragraph	
Tool, scarifier tooth removing	429581	3-1	2-14k	Removing tooth from scarifier shank



MEC 3805-237-12/3-1

Figure 3-1. Special tools.

#### 3-2. Basic Issue Tools and Equipment

Tools and repair parts issued with or authorized for use with the motor grader are listed in the Basic Issue Items List, Appendix B of this manual.

## Section II. LUBRICATION

#### 3-3. General Lubrication Information

a. This section contains a reproduction of the lubrication order and lubrication instructions which are supplemental to, and not specifically covered in the lubrication order.

#### 3-4. Detailed Lubrication Information

a. *General.* Keep all lubricants in closed containers and store in a clean dry place away from external heat. Allow no dust, dirt, or other foreign material to mix with the lubricants.

b. *Cleaning.* Clean lubricant from all external parts not requiring lubrication. Before lubricating the equipment, wipe all lubrication points free of dirt and grease. Clean all lubri-

cation points after lubricating to prevent accumulation of foreign matter.

c. *Points of Lubrication.* Service the points of lubrication at proper intervals as illustrated in figure 3-2.

d. *Localized Lubrication Points.* Refer to figure 3-2 for localized lubrication points. All grease fittings are circled and should be lubricated with grease (GAA), using a pressure grease gun every 10 hours or daily.

e. *Crankcase Oil Level.*

- (1) Crankcase oil level must be checked frequently. Refer to figure 3-3 for oil level gage.
- (2) Oil may require changing more frequently than usual because of con-

# LUBRICATION CHART

## GRADER, ROAD, MOTORIZED: DIESEL DRIVEN; 12 FT MOLDBOARD (WABCO-CED MODEL 440HA) W/ENGINE GM MODEL 4057

### REFERENCE:

C9100-1L

Intervals are based on normal hours of operation. Reduce to compensate for abnormal operation and severe conditions. During inactive periods, sufficient lubrication must be performed for adequate preservation.

Clean fittings before lubricating.

A dotted circle indicates a drain below.

Relubricate after washing or fording.

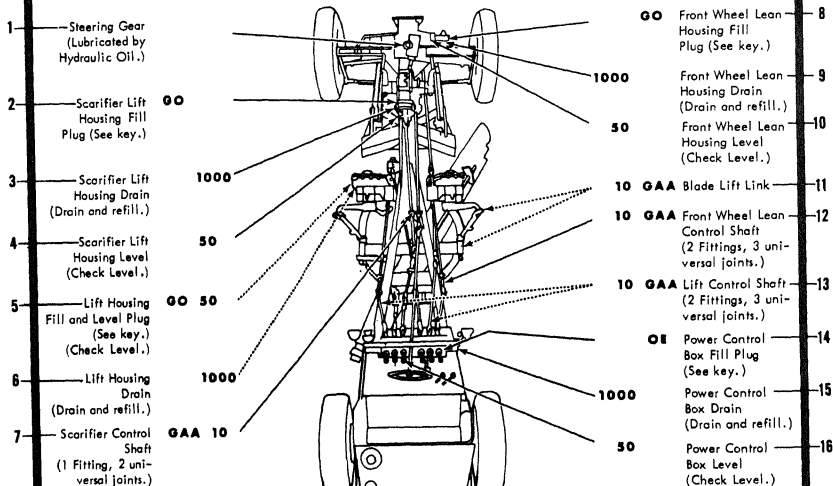
Clean parts with SOLVENT, dry-cleaning, or with OIL, fuel, Diesel. Dry before lubricating.

Lubricate points indicated by dotted arrow shafts on both sides of equipment.

Drain gear cases only when hot after operation; replenish and check level when cool.

### LUBRICANT • INTERVAL

### INTERVAL • LUBRICANT



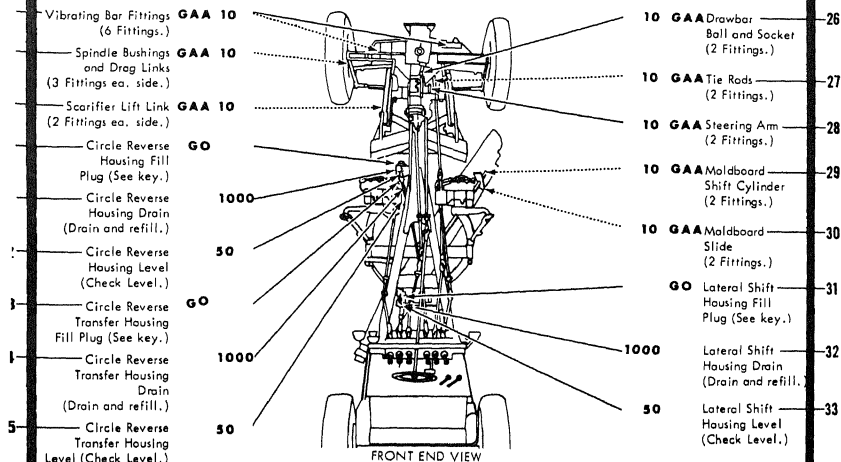
FRONT END VIEW

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LUBRICANT • INTERVAL

INTERVAL • LUBRICANT



-KEY-

LUBRICANTS	CAPACITY	EXPECTED TEMPERATURES			INTERVALS
		Above +32°F	+40°F to +10°F	0°F to -65°F	
OE-OIL, Engine, Heavy Duty					
Power Control Box	7 pts.				
Oil Can Points		OE 30	OE 10	OES	
OES-Oil, Engine, Sub-Zero					
GO-LUBRICATING OIL, Gear					
Circle Reverse Transfer Housing	0.66 pts.				Intervals given are in hours of normal operation.
Scarifier Lift Housing	24.5 pts.				
Lift Housing	3 pts. ea.				
Front Wheel Lean Housing	8 pts.				
Circle Reverse Housing	5 pts.				
Lateral Shift Housing	15.5 pts.				
Lateral Shift Gear Reduction Housing	3.5 pts.				
GOS-LUBRICATING OIL, Gear, Sub-Zero					
GAA-GREASE, Automotive and Artillery		ALL TEMPERATURES			

NOTES:

1. FOR OPERATION OF EQUIPMENT IN PROTRACTED COLD TEMPERATURES BELOW +10°F. Remove lubricants prescribed in the key for temperatures above +10°F. Clean parts with SOLVENT, dry, clean, relubricate with lubricants specified in the key for temperatures below +10°F.

2. OIL CAN POINTS. Every 50 hours, lubricate linkage pins, clevises, and all exposed threads with OE.

3. UNIVERSAL JOINTS. At disassembly, repack with GAA.

# LUBRICATION CHART

## GRADER, ROAD, MOTORIZED: DIESEL DRIVEN; 12 FT MOLDBOARD (WABCO-CED MODEL 440HA) W/ENGINE GM MODEL 4057

### REFERENCE:

C9100-1L

Intervals are based on normal hours of operation. Reduce to compensate for abnormal operation and severe conditions. During inactive periods, sufficient lubrication must be performed for adequate preservation.

Clean fittings before lubricating.

A dotted circle indicates a drain below.

Relubricate after washing or fording.

Clean parts with SOLVENT, dry-cleaning, or with OIL, fuel, Diesel. Dry before lubricating.

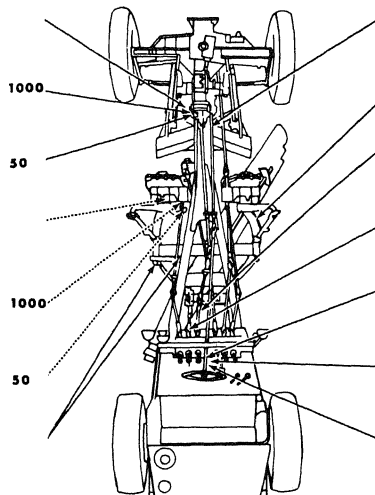
Lubricate points indicated by dotted arrow shafts on both sides of equipment.

Drain gear cases only when hot after operation; replenish and check level when cool.

LUBRICANT • INTERVAL

INTERVAL • LUBRICANT

- 34 — Scarifier Gear Reduction Housing Fill Plug (See key.) **GO**
- 35 — Scarifier Gear Reduction Housing Drain (Drain and refill.) **1000**
- 36 — Scarifier Gear Reduction Level (Check Level.) **50**
- 37 — Lift Gear Reduction Housing Fill Plug (See key.) **GO**
- 38 — Lift Gear Reduction Housing Drain (Drain and refill.) **1000**
- 39 — Lift Gear Reduction Housing Level (Check Level.) **50**
- 40 — Lateral Shift Link (2 Fittings.)

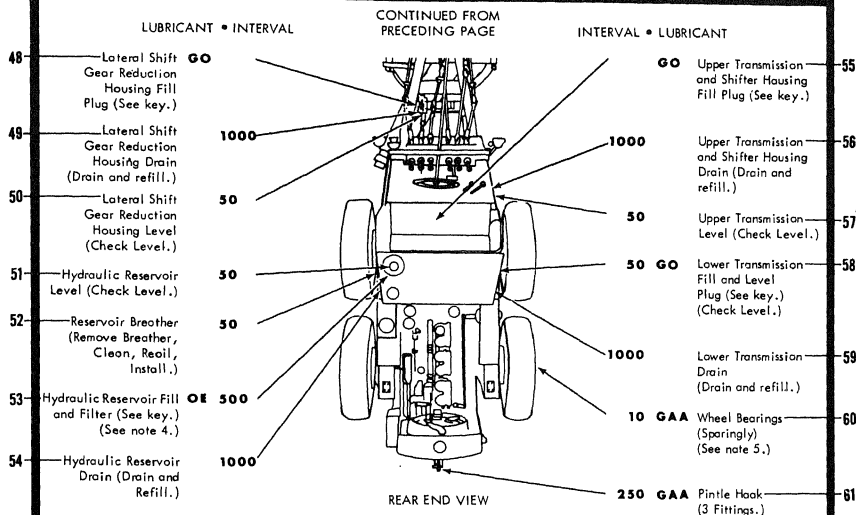


- 10 **GAA** Steering Control Shaft (2 Fittings, 2 universal joints.) **41**
- 10 **GO** Circle Flange (See note 3.) **42**
- 10 **GAA** Circle Reverse Control Shaft (3 Fittings, 4 universal joints.) **43**
- GAA** Lateral Shift Control Shaft (2 Universal joints.) **44**
- GO** Power Control Box Vertical Drive Housing Fill Plug (See key.) **45**
- GO** Power Control Box Vertical Drive Housing Drain (Drain and refill.) **46**
- 50** Power Control Box Vertical Drive Housing Level (Check Level.) **47**

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MEC 3805-237-12/3-2 (3)

Figure 3-2 ③.—Continued.



LUBRICANTS		CAPACITY	EXPECTED TEMPERATURES			INTERVALS
			Above +32°F	+40°F to -10°F	0°F to -65°F	
OE-OIL, Engine, Heavy Duty		32.5 pts.	OE 20	OE 10	OES	Intervals given are in hours of normal operation.
Hydraulic System						
Oil Can Points						
OES-OIL, Engine, Sub-Zero			OE 30	OE 10	OES	
GO-LUBRICATING OIL, Gear						
Scarifier Gear Reduction Housing		1.5 pts.	GO 90	GO 80	GOS	
Lift Gear Reduction Housing		3.5 pts. eo.				
Power Box Vertical Drive Shaft Housing		7.75 pts.				
Lateral Shift Gear Reduction Housing		3.5 pts.				
Upper Transmission		12 pts.				
Lower Transmission		63 pts.				
GOS-LUBRICATING OIL, Gear, Sub-Zero						
GAA-GREASE, Automotive and Artillery			ALL TEMPERATURES			

**NOTES:**

- FOR OPERATION OF EQUIPMENT IN PROTRACTED COLD TEMPERATURES BELOW -10°F. Remove lubricants prescribed in the key for temperatures above -10°F. Clean parts with SOLVENT, dry-cleaning. Relubricate with lubricants specified in key for temperatures below -10°F.
- OIL CAN POINTS. Every 50 hours, lubricate linkage, pins, clevises, and all exposed threads with OE.
- CIRCLE FLANGE. Flush circle flange and apply coat of GO.
- HYDRAULIC RESERVOIR AND FILTER. Fill reservoir to full mark. Start engine and operate all hydraulic controls.

Check level and bring to full mark. Change filter elements every 500 hours.

- WHEEL BEARINGS. Every 1000 hours remove, clean, inspect and lubricate and reassemble.
- UNIVERSAL JOINTS. At disassembly, repack with GAA.

# LUBRICATION CHART

## GRADER, ROAD, MOTORIZED: DIESEL DRIVEN; 12 FT MOLDBOARD (WABCO-CED MODEL 440HA) W/ENGINE GM MODEL 4057

### REFERENCE:

C9100-1L

Intervals are based on normal hours of operation. Reduce to compensate for abnormal operation and severe conditions. During inactive periods, sufficient lubrication must be performed for adequate preservation.

Clean fittings before lubricating.

A dotted circle indicates a drain below.

Relubricate after washing or fording.

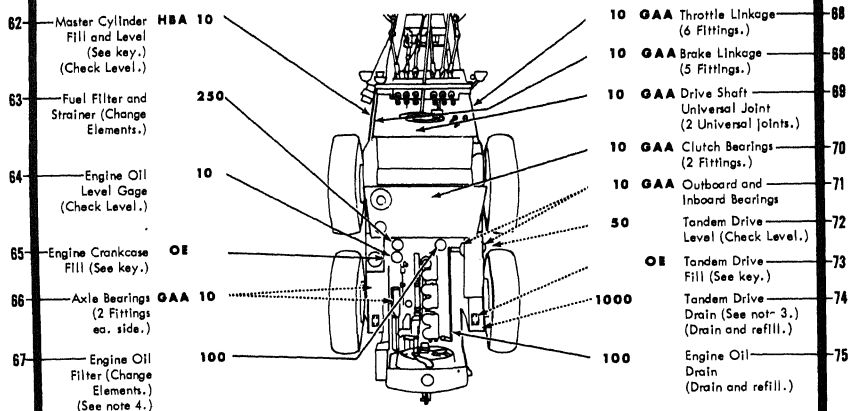
Clean parts with SOLVENT, dry-cleaning, or with OIL, fuel, Diesel. Dry before lubricating.

Lubricate points indicated by dotted arrow shafts on both sides of equipment.

Drain gear cases only when hot after operation; replenish and check level when cool.

### LUBRICANT • INTERVAL

### INTERVAL • LUBRICANT



REAR END VIEW

CONTINUED ON  
FOLLOWING PAGE

CONTINUED FROM  
PRECEDING PAGE

-KEY-

LUBRICANTS	CAPACITY	EXPECTED TEMPERATURES			INTERVALS
		Above +32°F	+40°F to -10°F	0°F to -65°F	
OE- OIL, Engine, Heavy Duty		OE 30	OE 10	OES	Intervals given are in hours of normal operation
Engine Crankcase	12 qts.				
Tandems	32 pts. ea.				
Oil Can Points					
OES- OIL, Engine, Sub-Zero		ALL TEMPERATURES			
HBA- HYDRAULIC FLUID, Non-Petroleum					
Master Cylinder	1.25 qts.				
GAA- GREASE, Automotive and Artillery					

NOTES:

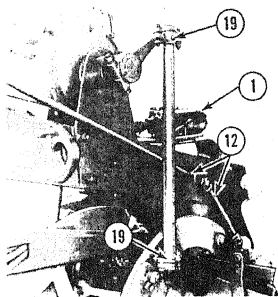
1. FOR OPERATION OF EQUIPMENT IN PROTRACTED COLD TEMPERATURES BELOW -10°F. Remove lubricants prescribed in key for temperatures above -10°F. Clean parts with SOLVENT, dry-cleaning. Relubricate with lubricants specified in key for temperatures below -10°F.

2. OIL CAN POINTS. Every 50 hours, lubricate linkage pins, clevises and all exposed threads with OE.

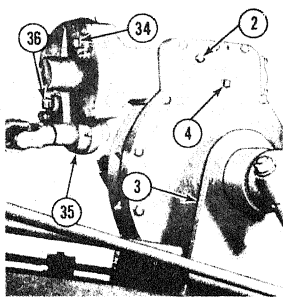
3. TANDEM DRAIN. Every 1000 hours drain tandems. Place tandems in uphill position and remove tandem level and drain plug.

4. ENGINE OIL FILTER. After installing new element, fill crankcase, operate engine 5 minutes, check filter housing for leaks, check crankcase oil level and fill to proper level.

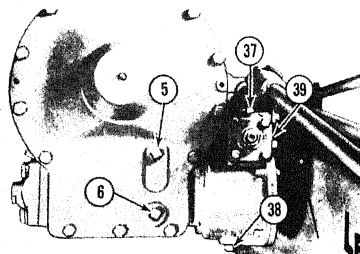
5. UNIVERSAL JOINTS. At disassembly repack with GAA.



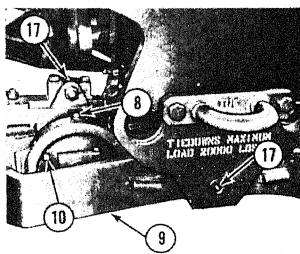
REF. 1. STEERING GEAR  
REF. 12. FRONT LEAN WHEEL CONTROL SHAFT  
REF. 19. SCARIFIER LIFT LINK



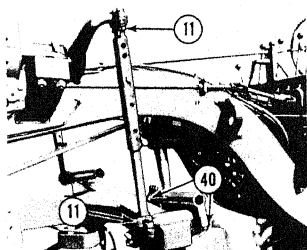
REF. 2. SCARIFIER LIFT HOUSING FILL PLUG  
REF. 3. SCARIFIER LIFT HOUSING DRAIN  
REF. 4. SCARIFIER LIFT HOUSING LEVEL  
REF. 34. GEAR REDUCTION HOUSING FILL PLUG  
REF. 35. GEAR REDUCTION HOUSING DRAIN  
REF. 36. GEAR REDUCTION HOUSING LEVEL



REF. 5. LIFT HOUSING FILL AND LEVEL PLUG  
REF. 6. LIFT HOUSING DRAIN  
REF. 37. GEAR REDUCTION HOUSING FILL PLUG  
REF. 38. GEAR REDUCTION HOUSING DRAIN  
REF. 39. GEAR REDUCTION HOUSING LEVEL



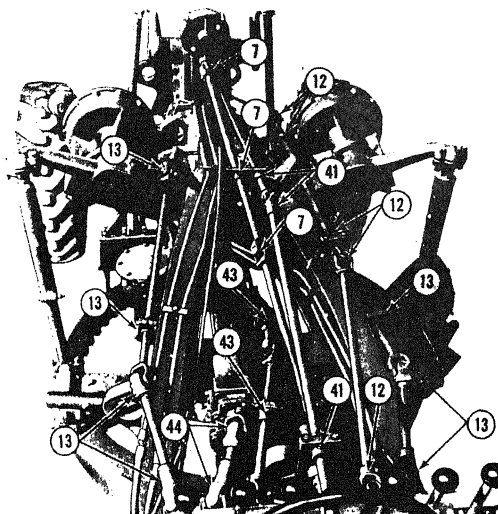
REF. 8. FRONT WHEEL LEAN HOUSING FILL PLUG  
REF. 9. FRONT WHEEL LEAN HOUSING DRAIN  
REF. 10. FRONT WHEEL LEAN HOUSING LEVEL  
REF. 17. VIBRATING BAR FITTINGS



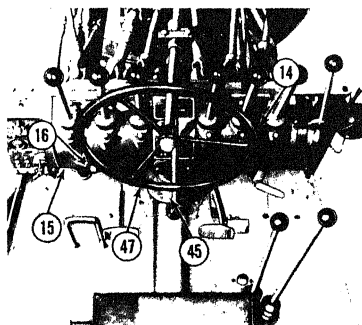
REF. 11. BLADE LIFT LINK  
REF. 40. LATERAL SHIFT LINK

MEC 3805-237-12/3-2 (7)

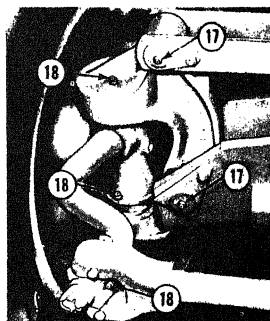




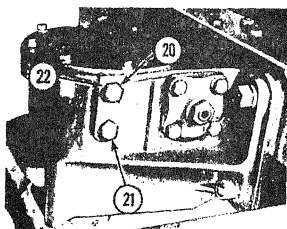
REF. 7. SCARIFIER CONTROL SHAFT  
 REF. 12. FRONT WHEEL LEAN CONTROL SHAFT  
 REF. 13. LIFT CONTROL SHAFT  
 REF. 41. STEERING CONTROL SHAFT  
 REF. 43. CIRCLE REVERSE CONTROL SHAFT  
 REF. 44. LATERAL SHIFT CONTROL SHAFT



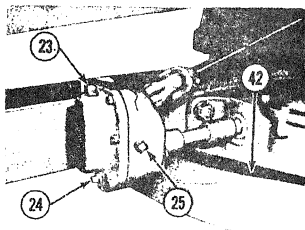
REF. 14. POWER CONTROL BOX FILL PLUG  
 REF. 15. POWER CONTROL BOX DRAIN  
 REF. 16. POWER CONTROL BOX LEVEL  
 REF. 45. VERTICAL DRIVE HOUSING FILL PLUG  
 REF. 47. VERTICAL DRIVE HOUSING LEVEL



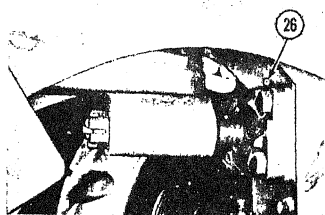
REF. 17. VIBRATING BAR FITTINGS  
 REF. 18. SPINDLE BUSHINGS AND DRAG LINKS



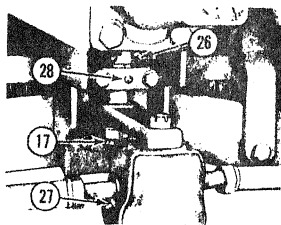
REF. 20. CIRCLE REVERSE HOUSING FILL PLUG  
REF. 21. CIRCLE REVERSE HOUSING DRAIN  
REF. 22. CIRCLE REVERSE HOUSING LEVEL



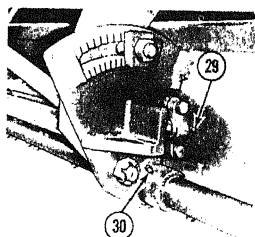
REF. 23. CIRCLE REVERSE TRANSFER HOUSING FILL PLUG  
REF. 24. CIRCLE REVERSE TRANSFER HOUSING DRAIN  
REF. 25. CIRCLE REVERSE TRANSFER HOUSING LEVEL  
REF. 42. CIRCLE REVERSE FLANGE



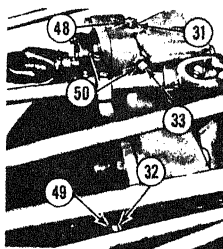
REF. 26. DRAWBAR BALL AND SOCKET



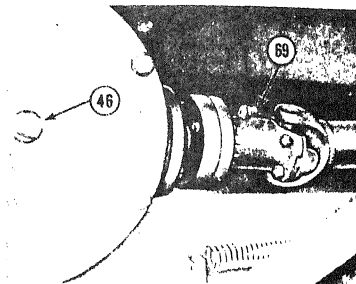
REF. 17. VIBRATING BAR FITTINGS  
REF. 26. DRAWBAR BALL AND SOCKET  
REF. 27. TIE RODS  
REF. 28. STEERING ARM



REF. 29. MOLDBOARD SHIFT CYLINDER  
REF. 30. MOLDBOARD SLIDE

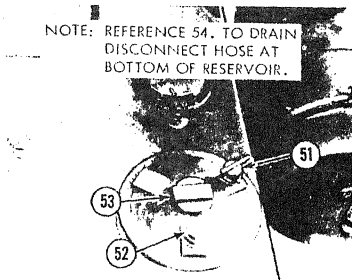


REF. 31. LATERAL SHIFT HOUSING FILL PLUG  
REF. 32. LATERAL SHIFT HOUSING DRAIN  
REF. 33. LATERAL SHIFT HOUSING LEVEL  
REF. 48. GEAR REDUCTION HOUSING FILL PLUG  
REF. 49. GEAR REDUCTION HOUSING DRAIN  
REF. 50. GEAR REDUCTION HOUSING LEVEL

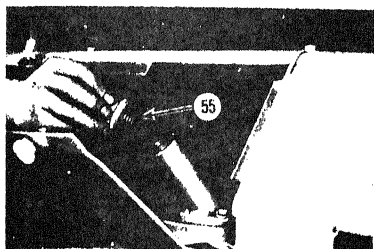


REF. 46. VERTICAL DRIVE HOUSING DRAIN  
REF. 69. DRIVE SHAFT UNIVERSAL JOINT

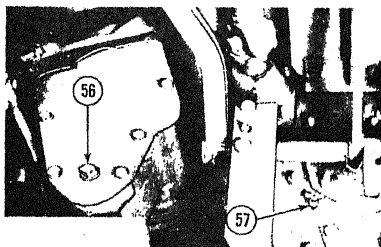
NOTE: REFERENCE 54. TO DRAIN  
DISCONNECT HOSE AT  
BOTTOM OF RESERVOIR.



REF. 51. HYDRAULIC RESERVOIR LEVEL  
REF. 52. RESERVOIR BREATHER  
REF. 53. HYDRAULIC RESERVOIR FILL  
AND FILTER  
REF. 54. HYDRAULIC RESERVOIR DRAIN



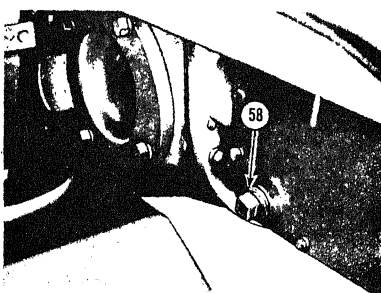
REF. 55. UPPER TRANSMISSION AND SHIFTER  
HOUSING FILL PLUG



REF. 56. SHIFTER HOUSING DRAIN  
REF. 57. UPPER TRANSMISSION LEVEL



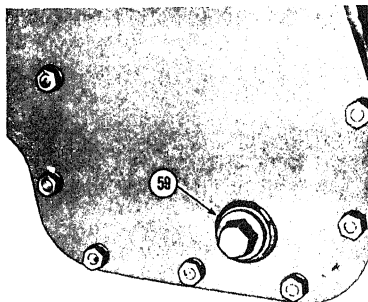
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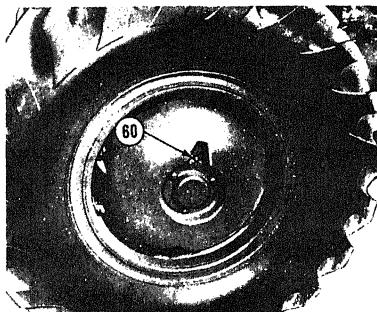
REF. 58. LOWER TRANSMISSION FILL AND  
LEVEL PLUG

MEC 3805-237-12/3-2 (10)

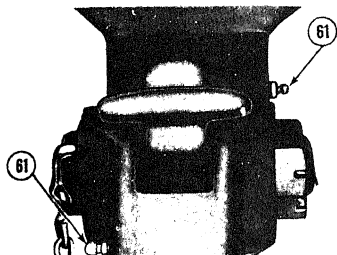
Figure 3-2 @.—Continued.



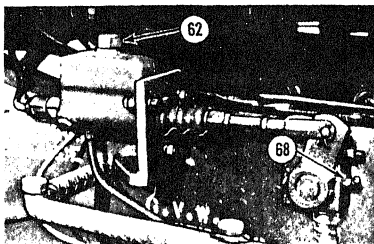
REF. 59. LOWER TRANSMISSION DRAIN



REF. 60. WHEEL BEARINGS

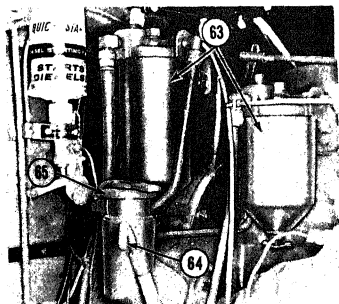


REF. 61. PINTLE HOOK



REF. 62. MASTER CYLINDER

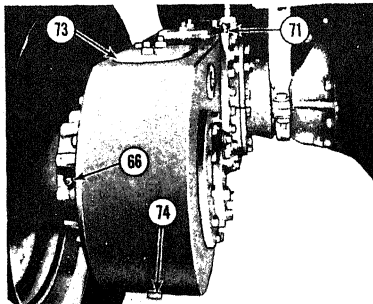
REF. 68. BRAKE LINKAGE



REF. 63. FUEL FILTER AND STRAINER

REF. 64. ENGINE OIL LEVEL GAGE

REF. 65. ENGINE CRANKCASE FILL



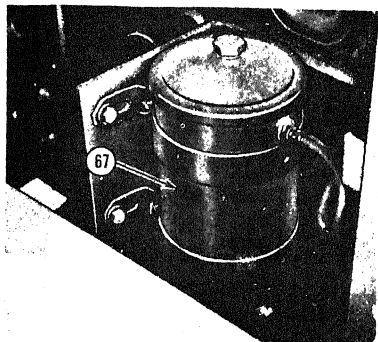
REF. 66. AXLE BEARINGS

REF. 71. INBOARD AND OUTBOARD BEARINGS

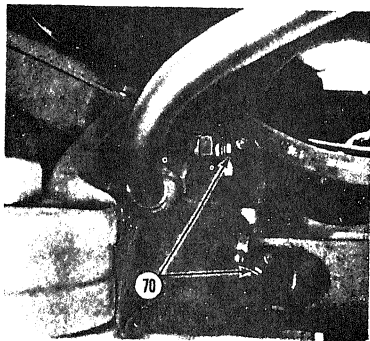
REF. 73. TANDEM DRIVE FILL

REF. 74. TANDEM DRIVE DRAIN

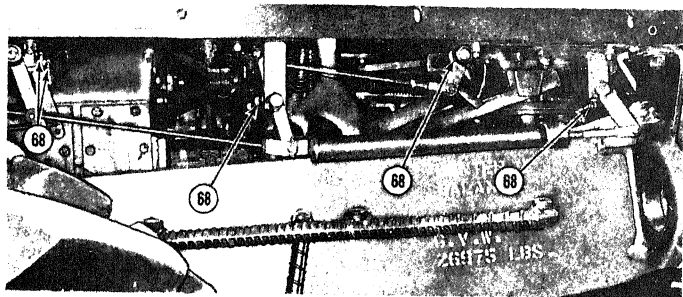
MEC 3805-237-12/3-2 (11)



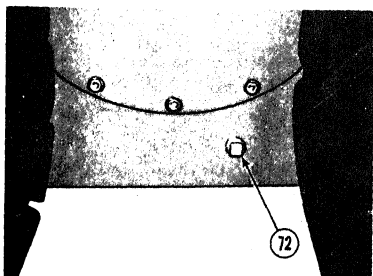
REF. 67. ENGINE OIL FILTER



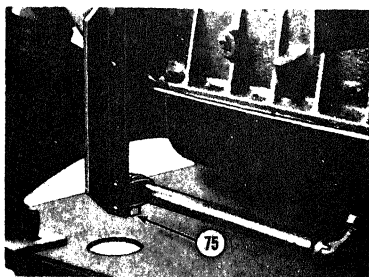
REF. 70. CLUTCH BEARINGS



REF. 68. THROTTLE LINKAGE



REF. 72. TANDEM DRIVE LEVEL



REF. 75. ENGINE OIL DRAIN

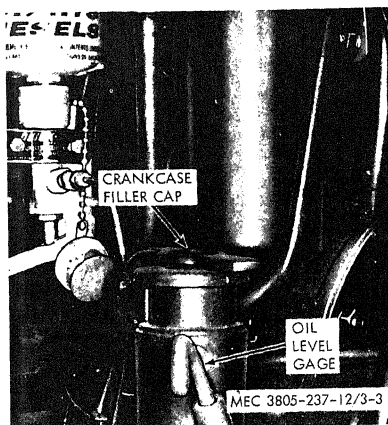


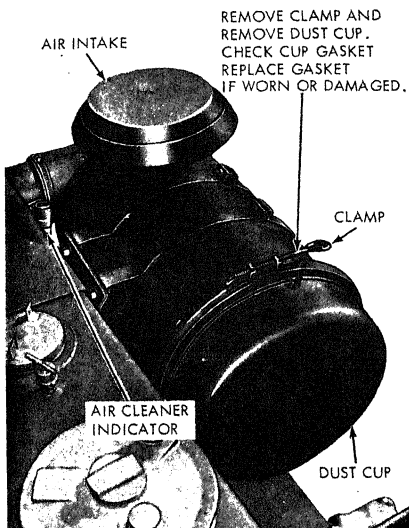
Figure 3-3. Oil level gage and filler cap.



Figure 3-4. Oil filter service.

tamination by dilution. Sludge formation will increase under cold weather operating conditions.

f. *Oil Filter Service.* Refer to figure 3-4 and service the engine oil filter.



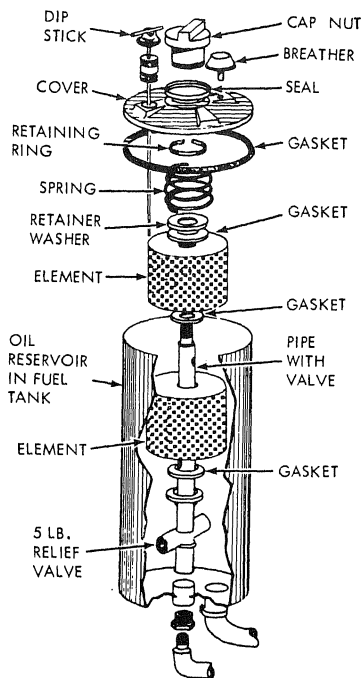
NOTE: REMOVE DUST CUP DAILY. CLEAN CUP AND GASKET BY WIPING CLEAN WITH CLOTH. CHECK AIR CLEANER INDICATOR. IF RED PISTON RISES TO TOP OF INDICATOR, REPLACE FILTER CARTRIDGE. REMOVE DUST CUP, REMOVE THUMB SCREWS AND REMOVE CARTRIDGE. CLEAN OR REPLACE CARTRIDGE EVERY 1000 HOURS, REGARDLESS OF INDICATOR POSITION.

MEC 3805-237-12/3-5

Figure 3-5. Air cleaner service.

g. *Air Cleaner Service.* Refer to figure 3-5 and service the air cleaner.

h. *Hydraulic Reservoir Filter.* Refer to figure 3-6 and service the hydraulic reservoir filter. The reservoir filter is mounted in the hydraulic reservoir.



STEP 1. REMOVE DIPSTICK AND CAP NUT.

STEP 2. REMOVE COVER AND GASKET.

STEP 3. REMOVE RETAINING RING, SPRING, UPPER ELEMENT, WASHER, AND GASKET.

STEP 4. REMOVE LOWER ELEMENT AND GASKET.

NOTE: CHANGE FILTER ELEMENT EVERY 500 HOURS OF OPERATION. CHECK AND CLEAN BREATHER EVERY 100 HOURS OF OPERATION.

MEC 3805-237-12/3-6

Figure 3-6. Hydraulic reservoir filter service.

### 3-5. General

To insure that the motor grader is ready for operation at all times, it must be inspected systemically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance services to be performed are listed and described in paragraphs 3-6 and 3-7. Item numbers indicate the minimum inspection requirements. Defects discovered during operation of the unit shall be noted for future correction, to be made as soon as operation has ceased. Stop operation immediately if deficiency is noticed which would damage equipment if operation were continued. All deficiencies and short comings will be recorded together with the corrective action taken on DA Form 2404 (Equipment Inspection and Maintenance Worksheet) at the earliest possible opportunity.

### 3-6. Daily Preventive Maintenance

This paragraph contains an illustrated tabulated listing of preventive maintenance services which must be performed by the operator. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to figure 3-7 for the daily preventive maintenance services.

### 3-7. Quarterly Preventive Maintenance Services

a. This paragraph contains an illustrated tabulated listing of preventive maintenance services which must be performed by organizational maintenance personnel at quarterly intervals. A quarterly interval is equal to 3 calendar months, or 250 hours of operation whichever occurs first.

b. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to figure 3-8 for the quarterly preventive maintenance services.

## Section IV. OPERATOR'S MAINTENANCE

### 3-8. General

Instructions in this section are published for the information and guidance of the operator to maintain the road grader.

### 3-9. Fuel Filter and Strainer Service

Refer to figure 3-8 and 3-9 and service the fuel filter and strainer.

### 3-10. Fan Belt Adjustment

a. Stop vehicle engine.

b. Refer to figure 3-10 and adjust fan belt tension.

## Section V. TROUBLESHOOTING

### 3-11. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the motor grader and its components. Each trouble symptom stated is followed by a list of probable causes. The possible remedy is described opposite the probable cause. Any trouble beyond the scope of organizational maintenance shall be reported to direct support maintenance.

### 3-12. Engine Fails to Start

<i>Probable cause</i>	<i>Possible remedy</i>
Battery disconnect switch not engaged.	Engage battery disconnect switch (para 2-12).
Defective batteries	Replace defective batteries (para 3-58).
Loose or defective wiring.	Tighten connections or replace defective wiring.
Defective starter	Replace starter (para 3-53).
No fuel	Fill fuel tank. Prime fuel filters (para 3-9).
Defective fuel system	Check fuel system and correct (para 3-40).

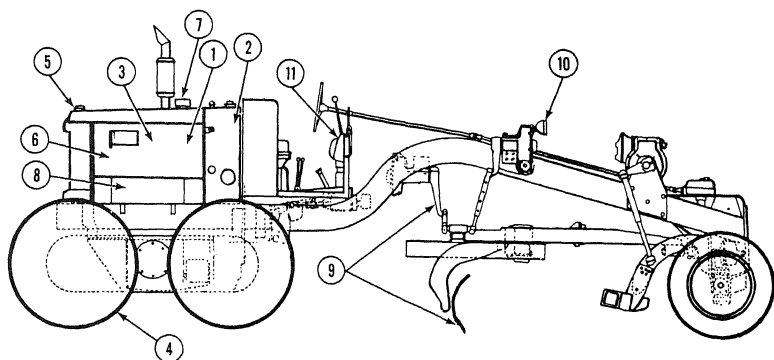


# DAILY

TM 5-3805-237-12

LETOURNEAU-WESTINGHOUSE MODEL 440HA

MOTOR GRADER



LUBRICATE IN ACCORDANCE WITH CURRENT LUBRICATION ORDER

ITEM		PAR REF
1	<u>FUEL FILTER AND STRAINER</u> . Drain 1/4 pint of fuel from filter and strainer to remove water and sediment.	3-9
2	<u>FUEL TANK</u> . Add fuel as required. Drain condensation from tank before and after each days operation.	3-41
3	<u>CRANKCASE OIL LEVEL GAGE</u> . Check oil level and add oil as necessary. Reference current L.O.	3-4
4	<u>TIRES</u> . Check tires for damage. Check tire pressures. Tires require 30 psi air pressure.	3-67
5	<u>RADIATOR</u> . Fill to proper level.	3-48
6	<u>FAN BELT</u> . Check deflection. Proper deflection is 1/2 to 3/4-inch midway between pulleys. (Check adjustment weekly.)	3-10
7	<u>AIR CLEANER</u> . Clean dust cup and service air cleaner.	3-4
8	<u>BATTERIES</u> . Check for loose cables and mountings. Tighten if necessary. Remove corrosion. Check level of electrolyte. Fill to 3/8-inch above plates. In freezing weather run engine for minimum of one hour after adding water. Clean vent holes in filler caps (weekly).	3-58

MEC 3805-237-12/3-7 ①

Figure 3-7 ①. Daily preventive maintenance services.

ITEM		PAR REF
9	<u>MOLDBOARD AND LINKAGES.</u> Clean all dirt and old grease from working parts.	3-77
10	<u>LIGHTS.</u> Check operation of running lights and floodlights.	3-56
11	<u>CONTROLS AND INSTRUMENTS.</u> Inspect all controls and instruments for damage and insecure mounting. With engine operating inspect for improper operation. Normal operating ranges for instruments are as follows: Ammeter Charge range Oil Pressure 30-60 psi Coolant Temperature 160-185°F	2-10
	<u>NOTE 1. OPERATION.</u> During operation observe for any unusual noise or vibration.  <u>NOTE 2 OPERATION</u> After the first 10 hours of operation, retorque the tandem axle nuts to 600 ft. lbs.	

MEC 3805-237-12/3-7 (2)

Figure 3-7 (2).—Continued.

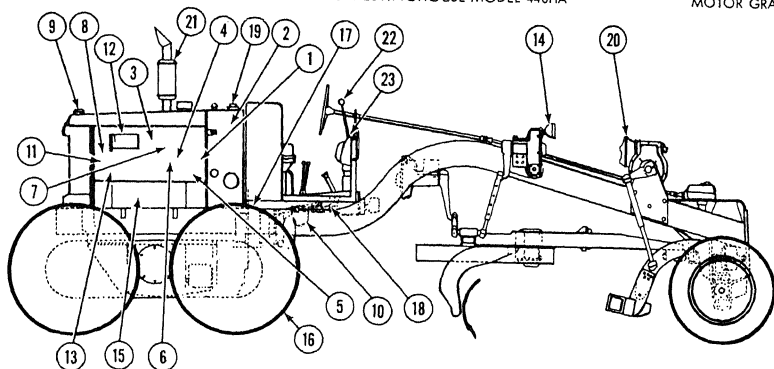
# PREVENTIVE MAINTENANCE SERVICES

## QUARTERLY

TM 5-3805-237-12

LETOURNEAU-WESTINGHOUSE MODEL 440HA

MOTOR GRADER



LUBRICATE IN ACCORDANCE WITH CURRENT LUBRICATION ORDER

ITEM		PAR REF
1	<b>FUEL FILTER AND STRAINER.</b> Inspect filter and strainer for insecure mounting and leaks at connections. Check fuel lines for leaks and damage. Drain water and sediment from shells. Install new filter and strainer elements.	3-9
2	<b>FUEL TANK.</b> Check for loose mounting and tighten if necessary. Check for leaking tank and replace if necessary. Check cap and vent. Replace cap gasket if necessary. Clean cap vent. Inspect fuel lines for leaks and damage. Clean fuel strainer at tank outlet.	3-41
3	<b>MECHANICAL GOVERNOR.</b> Check governor linkage for free movement and correct operation. Oil linkage at joints.	3-43
4	<b>CRANKCASE OIL LEVEL GAGE.</b> Check oil level. Add oil as necessary. Reference current L.O.	3-4
5	<b>ENGINE OIL FILTER.</b> Check oil lines for leaks and damage.	3-4
6	<b>FUEL PUMP.</b> Check fuel lines for leaks and damage. Check fuel pump for loose mounting and damage. Check fuel flow.	3-40

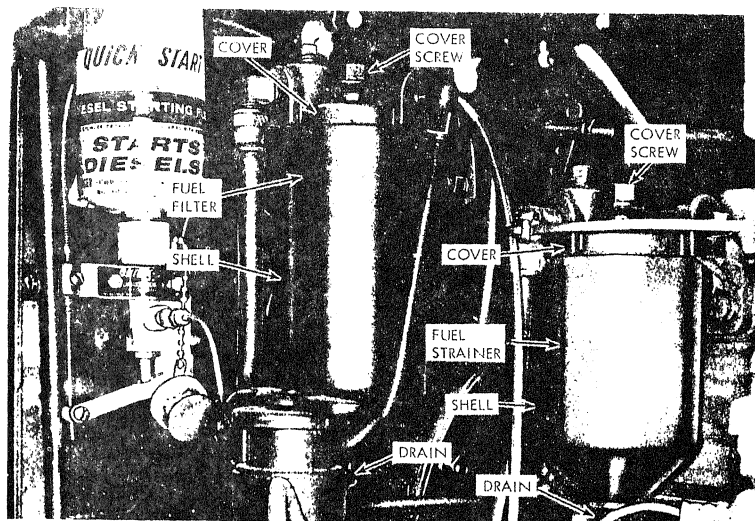
MEC 3805-237-12/3-8 (1)

Figure 3-8 (1). Quarterly preventive maintenance services.

ITEM		PAR REF
7	<u>INJECTOR LINES AND HOLDER ASSEMBLIES.</u> Check holder and lines for leaks and damage.	3-40
8	<u>WATER PUMP.</u> Inspect pump for leaks and loose mounting.	3-50
9	<u>RADIATOR.</u> Check for proper coolant level. Replace cracked or frayed hose. Replace leaking radiator. Clean air passages. Tighten all mountings and leaking connections. Check radiator cap for proper pressure.	3-48
10	<u>CLUTCH.</u> Check clutch pedal and linkage operation. Adjust if necessary.	3-39
11	<u>FAN BELT.</u> Check fan belt deflection. Correct deflection is 1/2 to 3/4-inch midway between pulleys. Adjust if necessary. Replace worn or stretched belts.	3-10
12	<u>GENERATOR.</u> Tighten loose mounting and electrical connections. Check regulator mounting and connections. Replace defective generator or regulator.	3-51
13	<u>STARTER.</u> Tighten loose mounting and electrical connections. Replace defective starter.	3-53
14	<u>LIGHTS.</u> Check running lights and floodlights for loose connections and damage. Replace defective lamp units or lights.	3-56
15	<u>BATTERIES.</u> Tighten loose cables and mounting. Clean corrosion from cables and batteries. Clean vent holes in filler caps. Replace a weak, cracked, or leaking battery.	3-58
16	<u>TIRES.</u> Inspect tires for leaks and damage. Replace damaged tires.	3-67
17	<u>BREATHERS.</u> Clean breathers or replace damaged breathers.	
18	<u>BRAKE CYLINDERS.</u> Inspect lines and cylinders for leaks. Replace defective cylinders and lines.	3-66
19	<u>HYDRAULIC RESERVOIR.</u> Inspect reservoir for leaks, damage and loose mounting. Tighten loose connections and mountings. Replace defective reservoir and lines. Replace filter elements.	3-68
20	<u>GEAR BOXES.</u> Inspect gear boxes and shafts for leaks and damage. Inspect control levers for damage. Replace defective shafts or control levers.	3-74 3-75
21	<u>EXHAUST SYSTEM.</u> Check exhaust system for leaks and damage. Replace damaged or defective parts.	3-45
22	<u>CONTROLS.</u> Start engine and operate all vehicle controls. Check for proper operation. Adjust if necessary.	2-10
23	<u>INSTRUMENTS.</u> Inspect instruments for damage and insecure mounting. Replace defective instruments. Normal operating ranges for instruments are as follows: <div style="display: flex; justify-content: space-between; margin-left: 100px;"> <div>Ammeter</div> <div>Charge range</div> </div> <div style="display: flex; justify-content: space-between; margin-left: 100px;"> <div>Oil Pressure</div> <div>30-60 psi</div> </div> <div style="display: flex; justify-content: space-between; margin-left: 100px;"> <div>Coolant Temperature</div> <div>160-185°F</div> </div>	
	<u>NOTE 1. OPERATIONAL TEST.</u> During operation observe for any unusual noises or vibrations.	
	<u>NOTE 2. ADJUSTMENTS.</u> Make all adjustments during operational test.	

MEC 3805-237-12/3-8 (2)

Figure 3-8 ②.—Continued.



NOTE: DRAIN WATER AND SEDIMENT FROM FILTER AND STRAINER DAILY.

- STEP 1. DRAIN FILTER OR STRAINER.
- STEP 2. REMOVE COVER SCREW.
- STEP 3. REMOVE SHELL FROM FILTER COVER. REMOVE GASKET FROM COVER.
- STEP 4. REMOVE FILTER OR STRAINER ELEMENT FROM SHELL.
- STEP 5. CLEAN SHELL WITH AN APPROVED CLEANING SOLVENT AND CLEAN CLOTH.
- STEP 6. AFTER INSTALLATION OF NEW ELEMENTS, PRIME FILTER AND STRAINER BY FILLING SHELL WITH CLEAN FUEL.
- STEP 7. INSTALL SHELL AND COVER GASKET IN COVER AND SECURE WITH COVER SCREW.

NOTE: CHANGE FILTER AND STRAINER ELEMENTS EVERY 300 HOURS OF OPERATION.

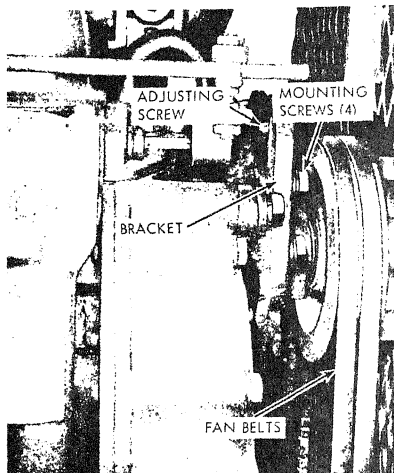
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Figure 3-9. Fuel filter and strainer service.

<i>Probable cause</i>	<i>Possible remedy</i>
Fuel filters not primed	Prime fuel filters (para 3-9).
Defective air system	Check air system and correct (para 3-6).

### 3-13. Engine Overheats

<i>Probable cause</i>	<i>Possible remedy</i>
Radiator coolant level low.	Inspect coolant level and refill if necessary.
Fan belt broken, loose, or slipping.	Adjust or replace fan belt (para 3-10).



- STEP 1. LOOSEN FOUR MOUNTING SCREWS.  
 STEP 2. TURN ADJUSTING SCREW CLOCKWISE TO TIGHTEN BELTS AND COUNTERCLOCKWISE TO LOOSEN BELTS.  
 STEP 3. CORRECT FAN BELT ADJUSTMENT IS 1/2 TO 3/4 INCH DEFLECTION MIDWAY BETWEEN PULLEYS.  
 STEP 4. TIGHTEN MOUNTING SCREWS SECURELY.

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Figure 3-10. Fan belt adjustment.

<i>Probable cause</i>	<i>Possible remedy</i>
Defective thermostat ---	Replace defective thermostat (para 3-49).
Radiator openings clogged.	Clean radiator and grille.
Defective coolant temperature gage.	Replace gage (para 3-54).
Operating machine in too low gear range.	Use proper gear (Table 2-2).

### 3-14. Engine Power Low

<i>Probable cause</i>	<i>Possible remedy</i>
Restricted air intake system.	Service air cleaner and hoses (para 3-6).
Defective fuel system	Check fuel system and correct (para 3-40).
Restricted exhaust system.	Check exhaust system and correct (para 3-43).

### 3-15. Engine Oil Pressure Low

<i>Probable cause</i>	<i>Possible remedy</i>
Crankcase oil level low	Replenish oil to bring to correct level on gage. Refer to current lubrication order.
External oil leak -----	Check oil lines and correct if possible.
Defective oil pressure gage.	Replace oil pressure gage (para 3-54).
Defective oil pump -----	Report this condition to direct support maintenance.

### 3-16. Engine Oil Consumption Excessive

<i>Probable cause</i>	<i>Possible remedy</i>
External oil leak -----	Check oil lines and correct if possible.
Improper oil viscosity ---	Drain and refill with oil of proper viscosity. Reference current lubrication order.

### 3-17. Electrical System not Providing Power

<i>Probable cause</i>	<i>Possible remedy</i>
Batteries low or defective.	Charge batteries or replace batteries (para 3-58).
Loose or defective ground cable.	Tighten ground cable or replace ground cable (para 3-58).
Defective generator ----	Replace defective generator (para 3-51).
Defective regulator ----	Replace defective regulator (para 3-51).

### 3-18. Fuel System not Operating Properly

<i>Probable cause</i>	<i>Possible remedy</i>
Clogged fuel tank strainer.	Clean or replace strainer (para 3-41).
Leaking or clogged fuel lines.	Tighten connection or replace fuel line.
Dirty or defective fuel filters.	Service fuel filters (para 3-9).
Contaminated fuel -----	Drain and clean fuel tank. Fill tank with clean fuel. Prime fuel filters (para 3-9).
Defective fuel pump ----	Replace defective fuel pump (para 3-40).
Fuel injection system not properly adjusted or defective injectors.	Report this condition to direct support maintenance.

### 3-19. Air Intake System not Operating Properly

<i>Probable cause</i>	<i>Possible remedy</i>
Clogged or defective air cleaner.	Service air cleaner (para 3-6).
Defective air cleaner hose.	Replace defective hose (para 3-6).

### 3-20. Exhaust System not Operating Properly

<i>Probable cause</i>	<i>Possible remedy</i>
Defective or restricted exhaust muffler or pipe.	Replace defective parts (para 3-45).
Loose or defective manifold or exhaust pipe clamps.	Tighten clamps.

### 3-21. Engine Cooling System not Operating Properly

<i>Probable cause</i>	<i>Possible remedy</i>
Coolant level low	Add coolant to radiator.
Leaking or defective radiator hoses or hose connections.	Tighten connections or replace hoses (para 3-48).
Loose or defective fan belt.	Service fan belt (para 3-10).
Clogged cooling system	Refer to TM 9-2858 to test systems and determine cause and corrective action. Clean and flush system. Replace components (para 3-48) if necessary.
Defective thermostat	Replace defective thermostat (para 3-49).
Clogged or defective radiator or grille.	Clean grille and radiator or replace (para 3-48).
Defective water temperature gage, sending unit, or wiring.	Replace defective parts.
Defective water pump	Report this condition to direct support maintenance.

### 3-22. Grader will not Move

<i>Probable cause</i>	<i>Possible remedy</i>
Parking brake engaged	Release brake.
Clutch not adjusted properly.	Adjust clutch (para 3-39).
Clutch defective	Report this condition to direct support maintenance.
Transmission defective	Report this condition to direct support maintenance.

### 3-23. Grader does not Steer Properly

<i>Probable cause</i>	<i>Possible remedy</i>
Hydraulic oil level low	Refill hydraulic oil reservoir. Reference lubrication order (fig. 3-2).
Defective hydraulic pump.	Replace defective pump (para 3-69).
Air in hydraulic lines	Bleed steering hydraulic system (para 3-69).
Front wheels not properly adjusted.	Check camber and castor adjustment (para 3-63).

<i>Probable cause</i>	<i>Possible remedy</i>
Front leaning wheels not operated properly according to function performed.	Refer to Section IV, Operation of Equipment.
Front wheels shimmy	Tighten steering connections. If not corrected, report this condition to direct support maintenance.

### 3-24. Moldboard does not Lift or Lower

<i>Probable cause</i>	<i>Possible remedy</i>
Shear bolt on propeller shaft broken.	Replace shear bolt (para 3-75).
Defective propeller shaft.	Replace shaft (para 3-75).
Lift link pin out	Install lift link pin (para 3-77).

### 3-25. Moldboard does not Angle Properly

<i>Probable cause</i>	<i>Possible remedy</i>
Circle binds	Check circle operation. If circle is bent report this condition to direct support maintenance.
Circle guide plates loose	Adjust guide plates (para 3-80).
Ball joints connecting to moldboard loose.	Adjust ball joints (para 3-80).
Circle reverse housing end thrust bearing not adjusted properly.	Adjust end thrust bearing (para 3-85).
Anti-coast brake not adjusted properly.	Adjust anti-coast brake (para 3-76).
Scarifier interfering with blade.	Lift scarifier out of way (para 2-14).

### 3-26. Moldboard does not Shift Properly

<i>Probable cause</i>	<i>Possible remedy</i>
Lateral shift end thrust bearing not adjusted properly.	Adjust end thrust bearing (para 3-76).
Lateral shift anti-coast brake not adjusted properly.	Adjust anti-coast brake (para 3-76).
Lateral shift links not adjusted properly.	Adjust lateral shift links (para 3-79).

### 3-27. Moldboard does not Power Shift Properly

<i>Probable cause</i>	<i>Possible remedy</i>
Hydraulic fluid low	Refill hydraulic reservoir. Reference lubrication order (fig. 3-2).
Hydraulic lines leaking or damaged.	Tighten connections or replace hydraulic lines (para 3-68).
Hydraulic pump defective.	Replace pump (para 3-69).

### 3-28. Scarifier does not Operate Properly

<i>Probable cause</i>	<i>Possible remedy</i>
Defective scarifier teeth	Replace defective teeth (para 2-14).
Improper operation	Refer to Section IV. Operation of Equipment, Operation of Scarifier.
Requires adjustment suitable to job requirement.	Refer to figure 2-15.

### 3-29. Clutch Brake does not Function Properly

<i>Probable cause</i>	<i>Possible remedy</i>
Brake not adjusted properly.	Adjust brake (para 3-39).
Pedal does not travel far enough to engage brake.	Adjust pedal travel (para 3-39).

### 3-30. Wheel Brakes do not Operate Properly

<i>Probable cause</i>	<i>Possible remedy</i>
Brake not adjusted correctly.	Adjust brakes (para 3-66).
Brake fluid low	Add fluid to master cylinder.
Hydraulic lines leaking	Tighten lines or replace defective lines (para 3-64).
Air in brake system	Bleed brake system (para 3-66).
Brake master cylinder defective.	Replace master cylinder (para 3-66).

<i>Probable cause</i>	<i>Possible remedy</i>
Brake wheel cylinders leaking or defective.	Replace brake wheel cylinder (para 3-66).
Brake linings worn	Report this condition to direct support maintenance.

### 3-31. Parking Brake does not Hold Vehicle

<i>Probable cause</i>	<i>Possible remedy</i>
Brake or linkage out of adjustment.	Adjust parking brake (para 3-66).
Brake lever bent or jammed.	Report this condition to direct support maintenance.
Brake lining worn	Report this condition to direct support maintenance.
Brake drum or shoes damaged.	Report this condition to direct support maintenance.

### 3-32. Anti-Coast Brakes do not Function Properly

<i>Probable cause</i>	<i>Possible remedy</i>
Anti-coast brake out of adjustment.	Adjust brakes (para 3-76).
Brake lining worn	Report this condition to direct support maintenance.
Brake damaged or defective.	Report this condition to direct support maintenance.

### 3-33. Tandem Drive Inoperative

<i>Probable cause</i>	<i>Possible remedy</i>
Worn chains or sprockets.	Report this condition to direct support maintenance.
Broken chain.	Report this condition to direct support maintenance.

## Section VI. RADIO INTERFERENCE SUPPRESSION

### 3-34. Definitions

a. *Interference.* The term "interference" as used herein applies to electrical disturbances in the radio frequency range which are generated by the motor grader and which may interfere with the proper operation of radio receivers or other electronic equipment, or enable the enemy to locate the equipment.

b. *Interference Suppression.* The term "interference suppression" as used herein applies to the methods used to eliminate or effectively reduce radio interference generated by the motor grader.

### 3-35. General Methods used to Attain Proper Suppression

Essentially, suppression is attained by providing a low resistance path to ground stray currents. Methods used include shielding the

ignition and high frequency wires, grounding the frame with bonding straps, and using capacitors and resistors.

### 3-36. Interference Suppression Components

a. *General.* The motor grader is equipped with a diesel engine and has no high frequency ignition wires. A generator supplies current to charge the vehicle batteries.

b. *Primary Interference Components.* The primary components are those whose primary function is to suppress radio interference. These components are described and located in figure 3-11.

### 3-37. Replacement of Interference Components

Refer to figure 3-11 and replace the radio interference components.



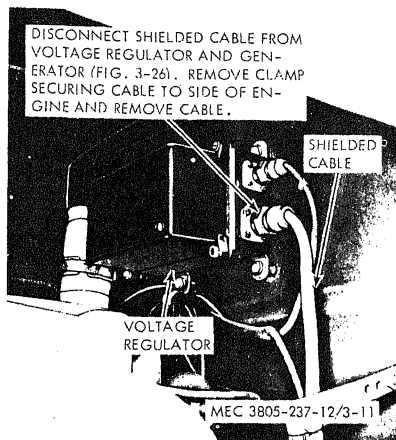


Figure 3-11. Radio interference components, removal and installation.

## Section VII. CLUTCH ASSEMBLY

### 3-38. General

The clutch is a 16 inch dry plate clutch manufactured by Rockford Clutch, splined directly to the crankshaft. The clutch is connected to the upper transmission by a drive shaft.

### 3-39. Clutch Pedal Adjustment

#### a. Clutch Pedal Travel.

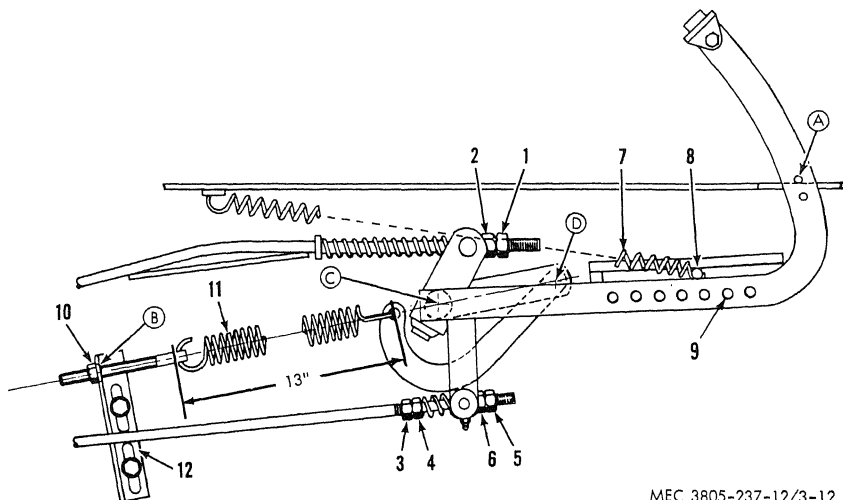
- (1) Clutch pedal must have approximately 2 inches of free pedal travel to engage the clutch.
- (2) Adjust for maximum travel with the upper hole on pedal arm (A, fig. 3-12) flush with floor plate.
- (3) Minimum travel is shown when lower hole is clutch arm is flush with floor plate. When this condition exists, adjustment must be made before serious damage to the clutch results.

#### b. Free Pedal Travel Adjustment.

- (1) Loosen locknut (1, fig. 3-12).
- (2) Move adjusting nut (2) until upper hole in clutch arm (A) is flush with

floor plate at end of free pedal travel, when pedal is depressed.

- (3) Tighten locknut (1) to hold adjustment.
- (4) Disconnect clutch return spring (7).
- (5) Depress clutch pedal until upper hole (A) is flush with floor plate.
- (6) Tighten or loosen stud nut (10) until outside loops of spring (11) are stretched approximately 13 inches apart.
- (7) Loosen screws holding angle bracket (12) and adjust angle bracket up or down until pedal can be positioned at the top or bottom of its free travel with approximately five pounds pressure. Tighten bracket screws. Spring stud hole (B) in bracket should be approximately in line with pivot points (C and D).
- (8) Return spring (7) must return and hold clutch pedal pad against bottom of floor plate. To adjust, insert a pry



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- 1 Locknut
- 2 Adjusting nut
- 3 Locknut
- 4 Adjusting nut
- 5 Locknut
- 6 Adjusting nut

- 7 Return spring
- 8 Anchor bolt
- 9 Stud nut
- 10 Swivel finger
- 11 Brake spring
- 12 Angle bracket

Figure 3-12. Clutch adjustment.

bar in one of the holes (9). Use bar as a pry point, loosen anchor bolt nut and pry anchor bolt (8) forward until spring tension holds pedal pad against floor. Tighten anchor bolt nut.

*c. Clutch Brake Adjustment.* With engine running, clutch brake must stop clutch in not less than three seconds and not more than four seconds after pedal has been fully depressed. Stopping the clutch greatly aids in shifting transmission without damage to gears.

- (1) Loosen locknut (3, fig. 3-12). Move

adjusting nut (4) until spring behind nut (4) is compressed  $\frac{1}{8}$ -inch when pedal is fully depressed.

- (2) Tighten locknut (3) to hold adjustment.
- (3) Loosen locknut (5) and tighten adjusting nut (6) against swivel finger to prevent rattle and looseness in linkage. Tighten locknut (5).
- (4) Check operation of brake and clutch under load to be sure adjustment is correct.

## Section VIII. FUEL SYSTEM

### 3-40. Fuel Pump

*a. Inspection.* Check fuel pump (fig. 3-13) for secure mounting. Tighten mounting bolts,

if necessary. Check fuel tubes for leaks and tighten or replace tubes.

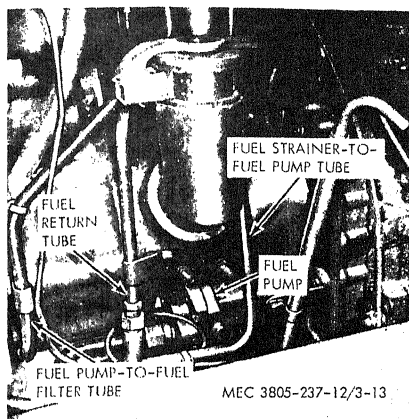


Figure 3-13. Fuel pump service and testing.

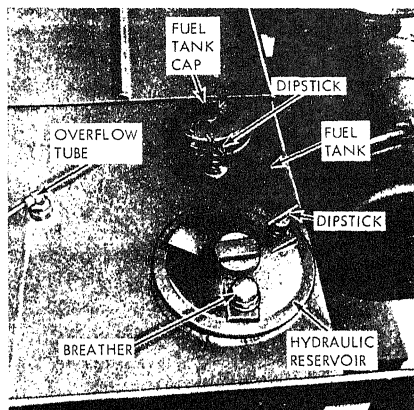
b. *Testing.* Test fuel flow through as follows.

- (1) Disconnect fuel return tube (fig. 3-13) from hose to fuel tank. Connect a hose to fuel return tube and hold hose in convenient receptacle.
- (2) Start the engine and run at 1200 revolutions per minute.
- (3) Measure fuel flow from tube for one minute.
- (4) A minimum of one-half gallon of fuel should flow in one minute.
- (5) If flow is less than one-half gallon, check fuel filters and service as described in paragraph 3-9.
- (6) Check fuel flow again (3 and 4 above). If flow is still below minimum, replace fuel pump.

### 3-41. Fuel Tank.

a. *Inspection.* Check fuel tank and fuel lines for evidence of leakage. If fuel has shown signs of water or other contamination, drain fuel tank and refill with clean fuel. Tighten fuel connections if necessary. Inspect fuel tank cap for good condition. Replace cap if defective. If fuel tank is defective, notify direct support maintenance to replace tank.

b. *Fuel Strainer.* A fuel strainer is placed in



- STEP 1. REMOVE CAP AND CHECK GASKET.
- STEP 2. CHECK OVERFLOW TUBE FOR DAMAGE.
- STEP 3. INSPECT FUEL TANK FOR LEAKS AND DAMAGE.

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Figure 3-14. Fuel tank service.

the tank outlet to filter large particles before they reach the fuel filter. Check and clean strainer, if necessary, by disconnecting fuel line and removing drain valve at bottom of tank.

### 3-42. Cold Weather Starting Aid

a. *Inspection.* Check fuel primer (fig. 3-15) for damage. Operate priming knob in operator's compartment and check primer for correct operation.

b. *Removal and Installation.*

- (1) Disconnect cable (fig. 3-15) from priming pump.
- (2) Disconnect tube to engine from priming pump.
- (3) Remove four screws securing starting aid to engine compartment and remove starting aid.
- (4) Install new starting aid in reverse order of removal.

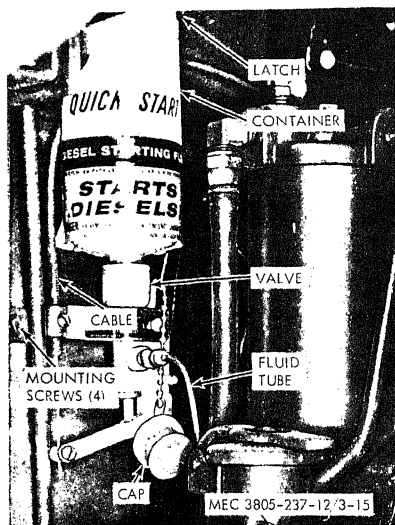


Figure 3-15. Cold weather starting aid service.

### 3-43. Governor and Throttle Linkage

*a. Governor Linkage.* Check governor lever (fig. 3-16) and shut off rod for damage and smooth operation. Pull ball in operator's compartment to check lever and rod operation. Lever must move enough to completely close governor to stop engine. If lever or rod is damaged, replace defective parts.

#### *b. Removal and Installation*

- (1) Remove ball from shutoff rod in operator's compartment. Remove retaining ring and insulating bushing.
- (2) Remove cotter pin (fig. 3-16) and washer and remove shutoff rod from lever.
- (3) Remove shoulder bolt (fig. 3-16), lockwasher and nut securing lever to bracket.
- (4) Disconnect lever from ball joint (fig. 3-16) and remove lever.
- (5) Remove ball joint from governor rod

(fig. 3-16) and remove rod from governor lever.

- (6) Install new governor rod (fig. 3-16) in governor lever and connect ball joint to rod.
- (7) Install lever (fig. 3-16) on bracket and secure with shoulder bolt, lockwasher and nut.
- (8) Connect ball joint to lever.
- (9) Slide new shutoff rod (fig. 3-16) into operator's compartment through insulating bushing and secure with retaining ring. Install ball on rod.
- (10) Install shutoff rod through hole in lever and secure with cotter pin (fig. 3-17) and washer.
- (11) Operate rod from operator's compartment to check operation.

*c. Throttle Linkage.* The foot throttle or pedals (accelerator and decelerator) (fig. 3-17) are mounted through holes in the floor of the operator's compartment. The front pedal is the accelerator. The rear or round pedal is the decelerator pedal. A hand throttle or governor control lever is mounted on the right side of the operator's compartment.

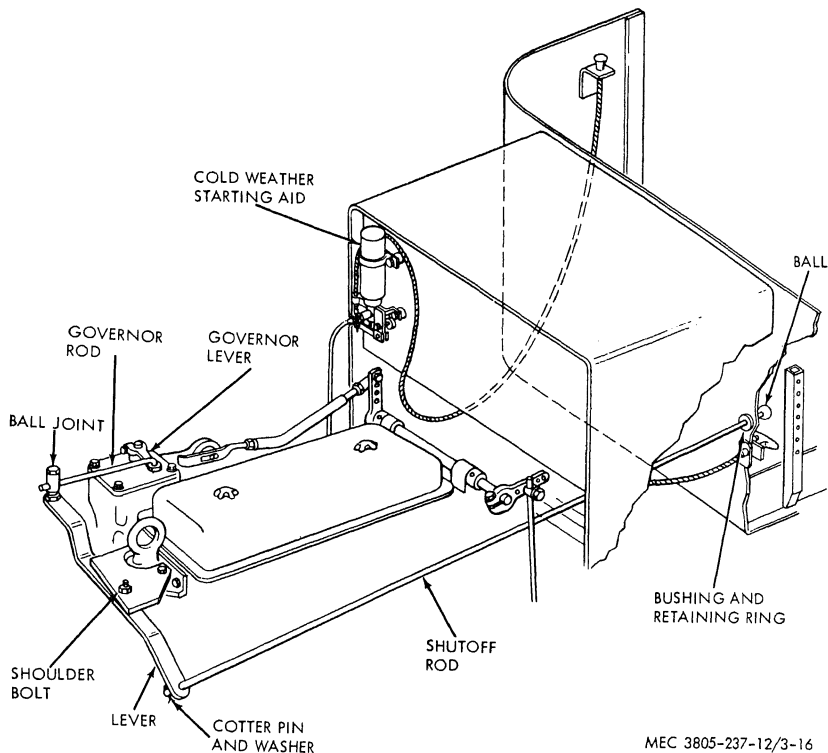
*d. Inspection.* Check operation of throttle linkage by depressing both foot pedals and moving governor control lever through complete travel. Linkage should operate smoothly and completely control governor. Governor control lever should stop and hold in any position, due to friction bearings in shaft. Check rods for bent condition or damage. Replace damaged parts in linkage. Lubricate seven lubrication fittings with grease (GAA) using a pressure grease gun every 250 hours.

*e. Removal.* Refer to figure 3-17 and remove the throttle linkage.

*f. Installation.* Refer to figure 3-17 and install the throttle linkage.

#### *g. Adjustment.*

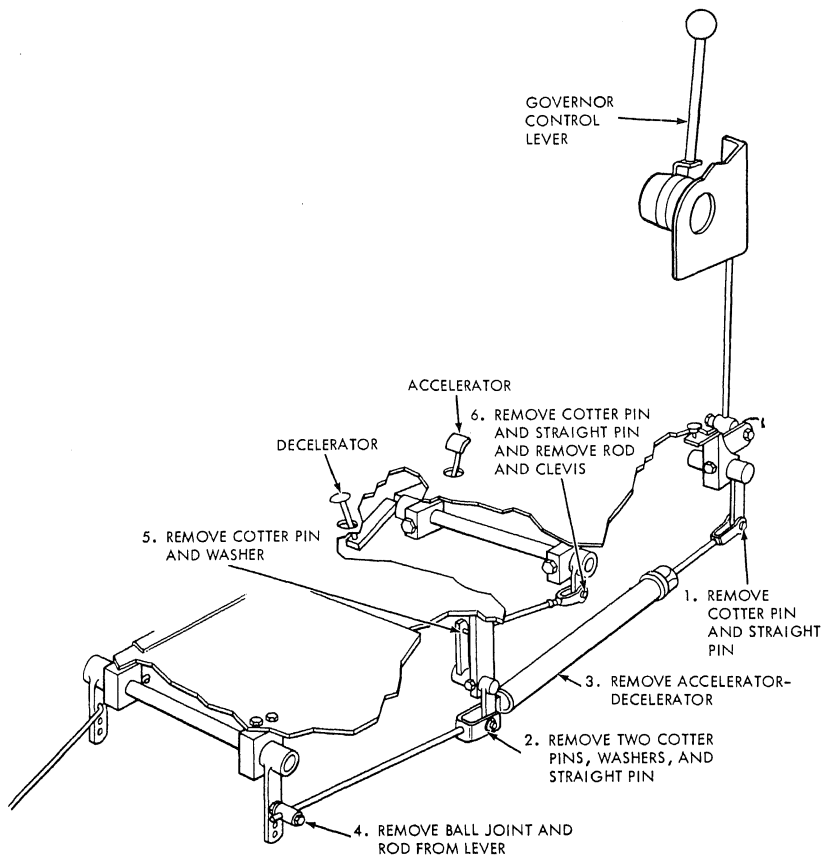
- (1) On installation, locate accelerator and governor control lever halfway between their stops for high and low speed.
- (2) Install all vertical linkage rods as nearly vertical as possible and all horizontal rods as horizontal as possible.



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Figure 3-16. Governor lever and linkage, removal and installation.

- (3) With engine off, place governor control lever (fig. 3-17) against full speed stop (all the way back). Adjust rod, attached to lever through floor plate, until accelerator—decelerator rod is pulled out of its housing  $\frac{3}{16}$  (0.1875) to  $\frac{1}{4}$  (0.250) inch. When governor control lever is against low speed stop, rod should be pushed into housing the same distance.
- (4) After making above adjustments, adjust length of rod from pedal support to accelerator—decelerator to prevent either pedal from striking floor plate.
- (5) After all adjustments, hook a spring scale to governor control lever as close to ball as possible. A pull of 8 to 25 pounds should be required to move lever through full range of travel.



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Figure 3-17. Throttle linkage, removal and installation.

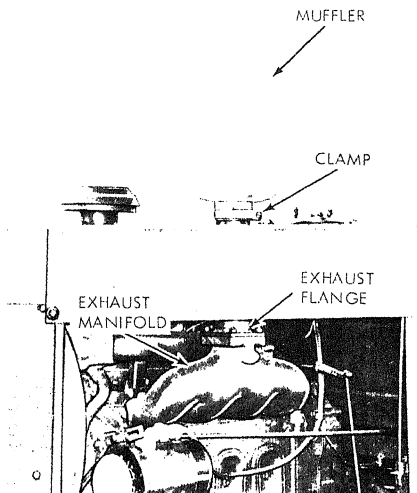
## Section IX. EXHAUST SYSTEM

### 3-44. Inspection

a. Check exhaust pipe and flange for evidence of leakage, cracks and other damage.

b. Inspect flange gasket and exhaust manifold and gasket for evidence of leakage.

c. Replace defective parts.



NOTE: SHUTOFF ENGINE AND ALLOW EXHAUST SYSTEM TO COOL OFF BEFORE ATTEMPTING TO REMOVE COMPONENTS.

- STEP 1. LOOSEN CLAMP AND REMOVE MUFFLER FROM EXHAUST FLANGE.
- STEP 2. REMOVE FOUR SCREWS AND LOCK WASHERS AND REMOVE EXHAUST FLANGE FROM MANIFOLD.
- STEP 3. REMOVE AND INSPECT EXHAUST FLANGE GASKET. DISCARD GASKET IF DAMAGED OR LEAKAGE IS EVIDENT.

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*Figure 3-18. Exhaust system, removal and installation.*

### 3-45. Muffler and Exhaust Flange

a. *Removal.* Refer to figure 3-18 and remove muffler and exhaust flange.

b. *Installation.* Refer to figure 3-18 and install the muffler and exhaust flange.

## Section X. COOLING SYSTEM

### 3-46. General

a. The motor grader cooling system consists of a fan, radiator, shroud, water pump, thermostat, hoses, and pipes.

b. Coolant pumped through the system by the water pump passes through the block around the pistons to cool the engine. It also flows through the oil cooler, cooling the oil before it returns to the engine.

### 3-47. Fan

a. *Removal.* Refer to figure 3-19 to remove the fan, fan shroud, fan spacer and fan bracket.

b. *Installation.* Refer to figure 3-19 to install the fan and its components.

### 3-48. Radiator

a. *Inspection.* Inspect radiator and hoses for leaks and deterioration. Check all hose connections and drain for leaks. Inspect radiator cap, cap spring, and cap gasket for damage. Replace defective parts.

b. *Removal.*

- (1) Remove plug (fig. 3-20) beneath radiator grille and drain coolant from radiator. Open drain (fig. 3-22) at bottom of oil cooler to drain cooler.
- (2) Refer to figure 3-21 and remove engine hood.
- (3) Loosen clamp (fig. 3-22) and remove radiator outlet and inlet hoses from radiator, oil cooler and thermostat housing.
- (4) Remove six screws and lockwashers securing radiator to frame and remove radiator as shown in figure 3-23.
- (5) Refer to paragraph 3-56 and remove blackout light, reflectors and floodlight from radiator.
- (6) Remove seven mounting screws (fig. 3-23) and lockwashers from each side and remove radiator shell (fig. 3-23) from radiator.

- (7) Remove four screws and lockwashers and remove grille from radiator shell.

c. *Installation.*

- (1) Install radiator grille on radiator shell and secure with four screws and lockwashers.
- (2) Install radiator shell and secure with fourteen screws (fig. 3-23) and lockwashers.
- (3) Install reflectors and lights (para 3-56).
- (4) Refer to figure 3-23 and install the radiator. Secure radiator with six screws and lockwashers.
- (5) Refer to figure 3-22 and install the radiator inlet and outlet hoses.
- (6) Refer to figure 3-21 and install engine hood.
- (7) Install plug (fig. 3-20) in radiator. Close drain (fig. 3-22) at bottom of oil cooler.
- (8) Remove plug at top of thermostat housing. Fill radiator with coolant until all air is forced from engine through plug hole. Install plug and complete filling of radiator.

### 3-49. Thermostat Housing and Thermostat

a. *Removal.*

- (1) Drain cooling system (para 3-48b).
- (2) Loosen clamps (fig. 3-22) and remove radiator inlet hose from radiator and thermostat housing.
- (3) Refer to figure 3-24 and remove thermostat housing and outlet elbow.

b. *Testing.*

- (1) Hook a wire to thermostat and lower thermostat into a container of water. Immerse an accurate thermometer, reading up to 200°F, in the water.
- (2) Heat water container. As water temperature reaches 170°F the thermostat should start to open. At 185°F



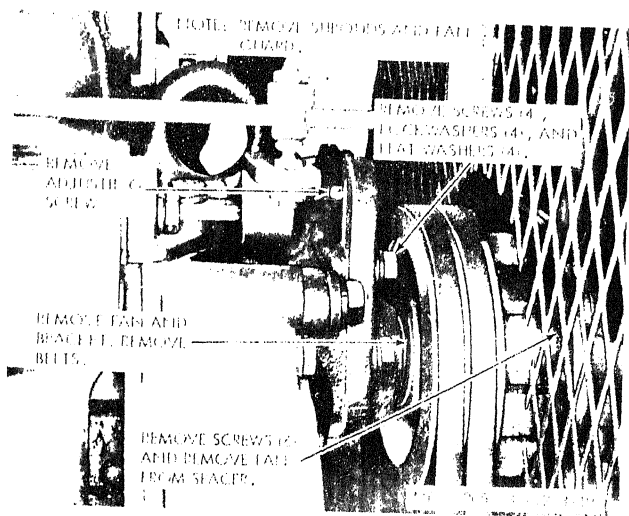
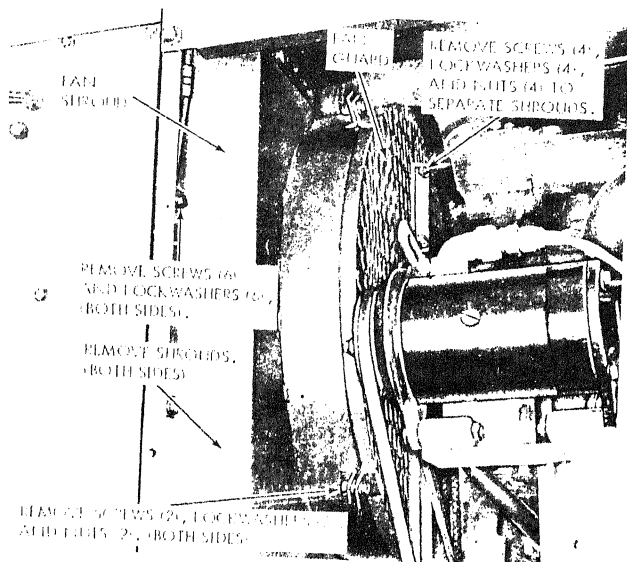


Figure 2-10. Fan and Shroud Removal.

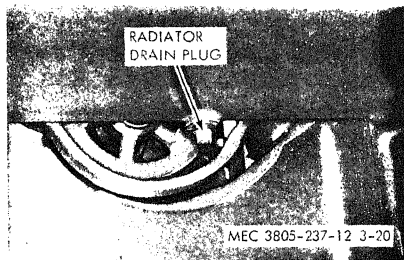


Figure 3-20. Radiator drain plug.

NOTE: LOOSEN CLAMPS AT THERMOSTAT HOUSING AND RADIATOR AND REMOVE RADIATOR INLET HOSE FROM TOP OF RADIATOR.

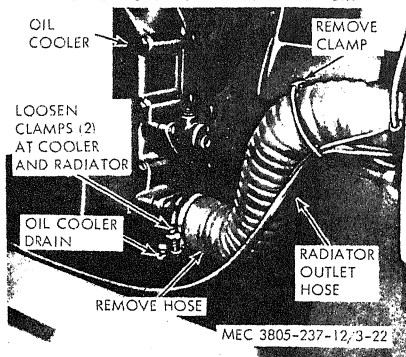


Figure 3-22. Radiator hoses, removal and installation.

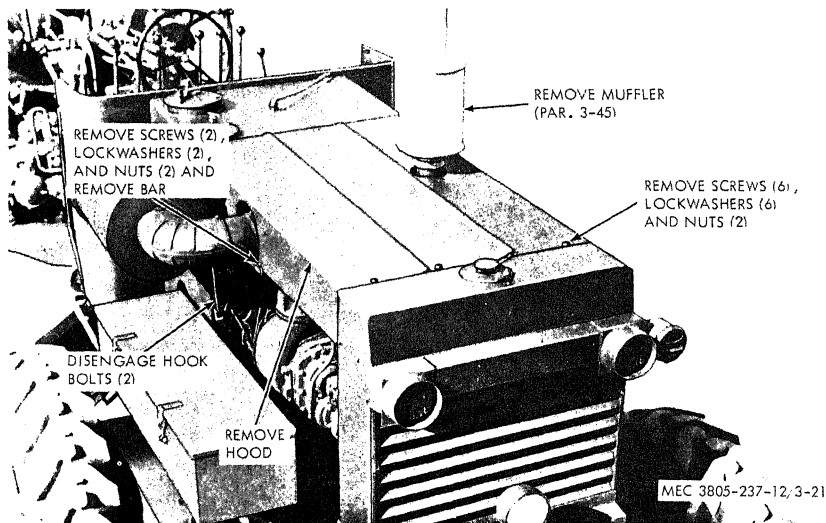
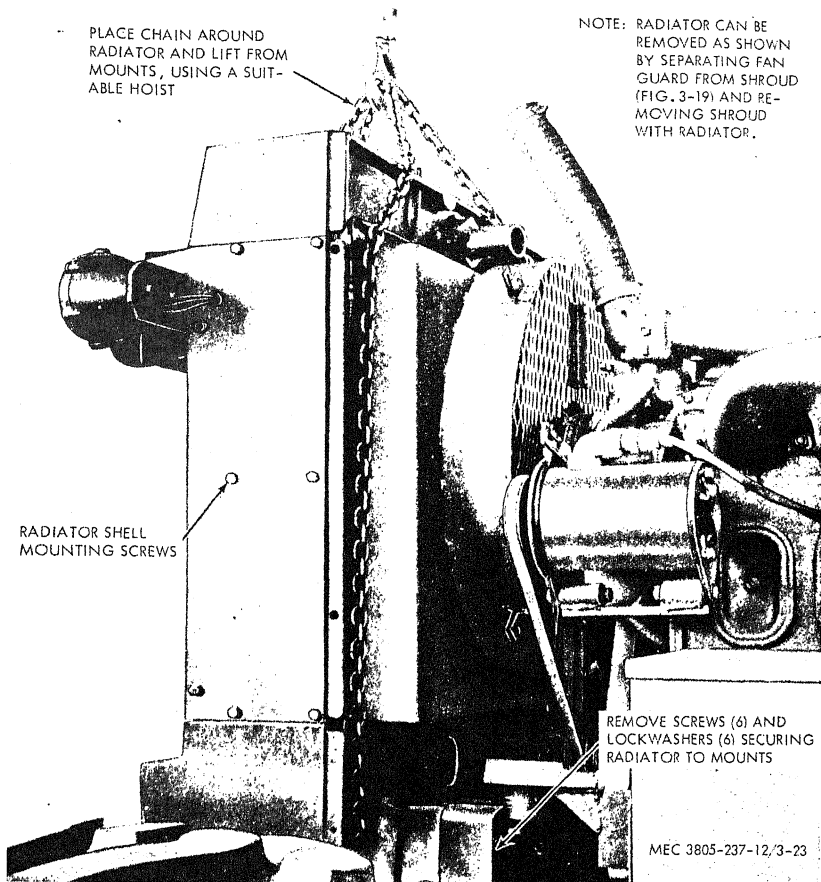


Figure 3-21. Engine hood, removal and installation.



*Figure 3-23. Radiator, removal and installation.*

the thermostat should be completely open.

- (3) If thermostat does not test as above, replace thermostat.

*c. Installation.*

- (1) Clean thermostat seat in housing.
- (2) Refer to figure 3-24 and install thermostat housing and thermostat. Install new gaskets between housing and

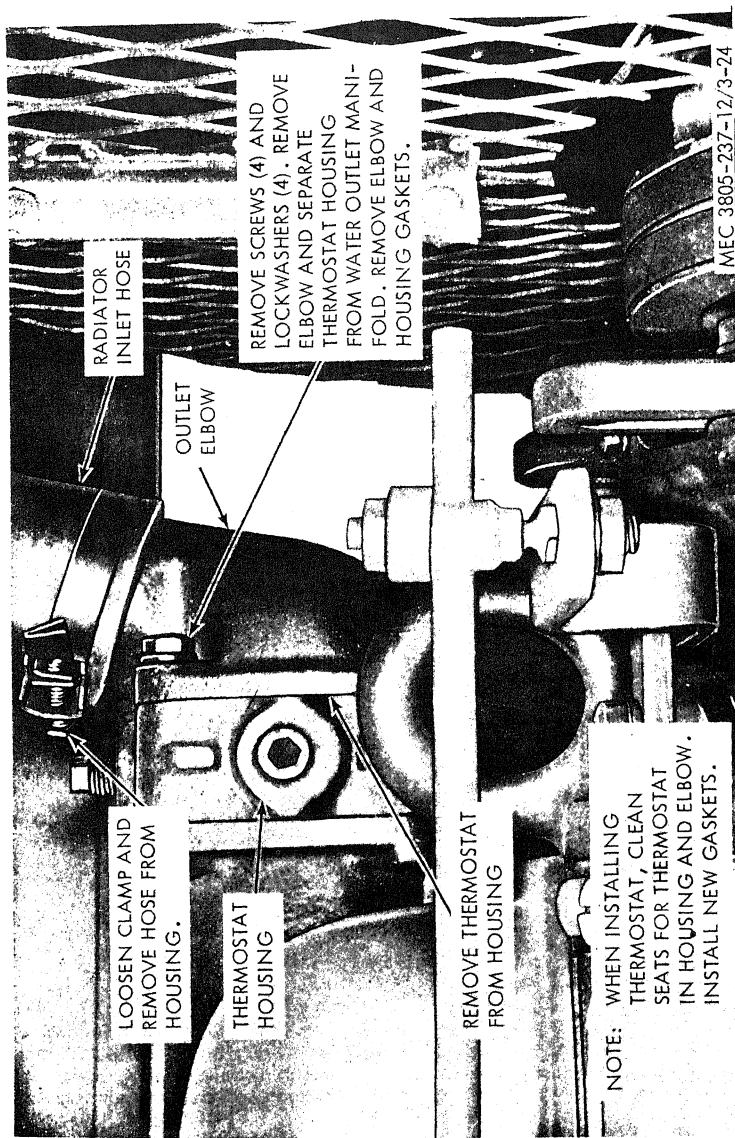


Figure 3-24. Thermostat and outlet elbow, removal and installation.

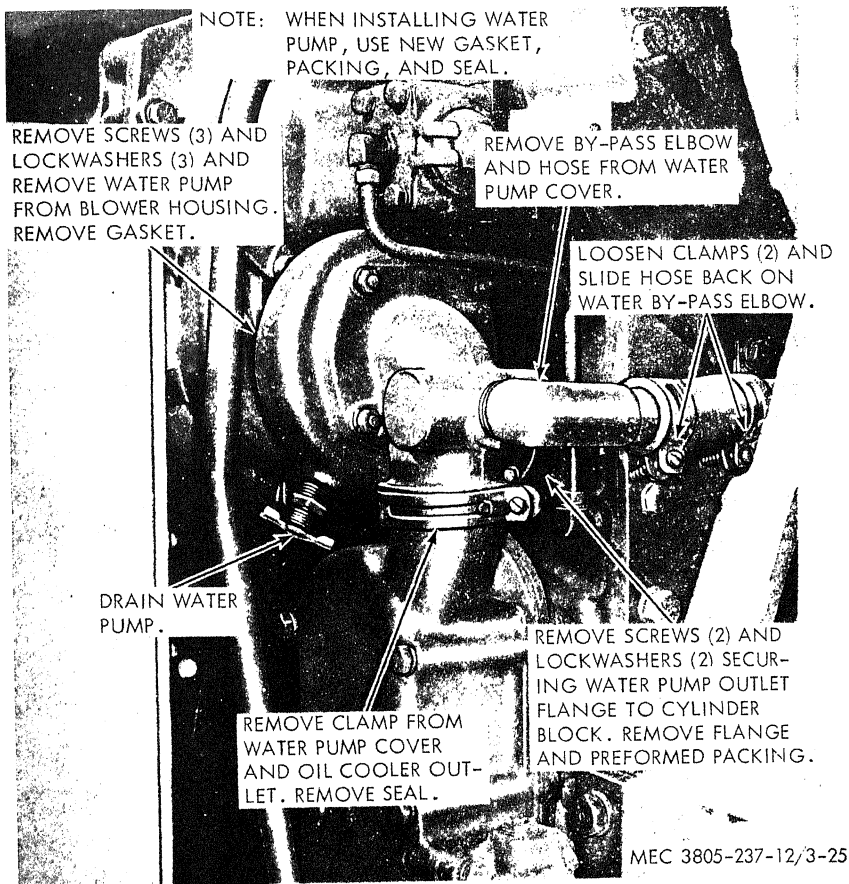


Figure 3-25. Water pump, removal and installation.

- water manifold and housing and outlet elbow.
- (3) Install hose between radiator and thermostat (para 3-48c).
- (4) Fill radiator with coolant (para 3-48c).

- (1) Drain cooling system (para 3-48b).
- (2) Refer to figure 3-25 and remove water pump.

b. *Installation.* Refer to figure 3-25 and install water pump. Install new gaskets and packing when installing water pump.

### 3-50. Water Pump

#### a. Removal.

## Section XI. ELECTRICAL SYSTEM

### 3-51. Generator

#### a. Belt Adjustment.

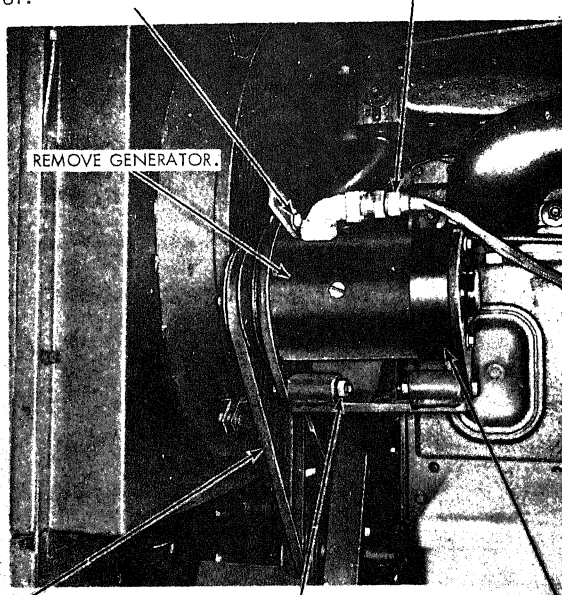
- (1) Loosen two generator mounting screws (fig. 3-26). Loosen generator adjusting screw.
- (2) Move generator towards engine to

loosen belt and away from engine to tighten belt.

- (3) Belt should have a deflection of  $\frac{1}{2}$  to  $\frac{3}{4}$  inches midway between the pulleys.
- (4) Tighten adjusting screw and mounting screws.

REMOVE GENERATOR ADJUSTING SCREW, LOCKWASHERS, AND NUT.

DISCONNECT SHIELDED CABLE FROM GENERATOR.



TO REPLACE GENERATOR BELT, REMOVE FAN (PAR. 3-47) AND FAN BELTS. LOOSEN GENERATOR ADJUSTING SCREW AND PUSH GENERATOR TOWARD ENGINE TO REMOVE BELT.

REMOVE GENERATOR MOUNTING SCREWS (2), LOCKWASHERS (2), AND NUTS (2).

TO REPLACE GENERATOR BRUSHES, REMOVE COVER BAND. LIFT BRUSH ARMS, REMOVE BRUSH LEAD SCREWS (2) AND REMOVE BRUSHES.

MEC 3803-237-12/3-26

Figure 3-26. Generator, adjustment, removal and installation.

**b. Removal.**

- (1) Place battery disconnect switch in disengaged position.
- (2) Refer to figure 3-26 and remove the generator.

**c. Inspection and Repair.**

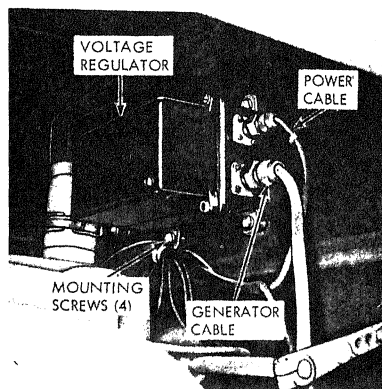
- (1) Inspect generator for damage and for evidence of arcing.
- (2) Refer to figure 3-26 and replace generator brushes if necessary.

**d. Installation.** Refer to figure 3-26 and install generator.

### 3-52. Voltage Regulator

**a. Removal.**

- (1) Place battery disconnect switch in the disengaged position.
- (2) Refer to figure 3-27 and remove voltage regulator.



- STEP 1. DISCONNECT POWER CABLE FROM VOLTAGE REGULATOR.
- STEP 2. DISCONNECT SHIELDED GENERATOR CABLE FROM VOLTAGE REGULATOR.
- STEP 3. REMOVE FOUR SCREWS AND LOCK-WASHERS AND REMOVE VOLTAGE REGULATOR.

MEC 3805-237-12/3-27

*Figure 3-27. Voltage regulator, removal and installation.*

**b. Installation.** Refer to figure 3-27 and install the voltage regulator.

### 3-53. Starter

**a. Removal.**

- (1) Place battery disconnect switch in the disengaged position.
- (2) Refer to figure 3-28 and remove the starter.

**b. Starter Solenoid.**

- (1) **Removal.** Disconnect wires and connector from solenoid terminals. Remove four screws and remove solenoid (fig. 3-28).
- (2) **Installation.** Install solenoid on starter and secure with four screws. Connect wires and connector to solenoid terminals.

*Note.* Install solenoid carefully to prevent damage to boot. Boot must fit in lever housing around solenoid plunger.

**c. Brushes.** Replace starter brushes if necessary.

- (1) **Removal.** Refer to figure 3-29 and remove starter brushes.
- (2) **Installation.** Refer to figure 3-29 and install starter brushes.

**d. Installation.** Refer to figure 3-28 and install the starter.

### 3-54. Instrument Panel Gages and Light

**a. Removal.**

- (1) Place battery disconnect switch in disengaged position.
- (2) Refer to figure 3-30 and remove gages and light from instrument panel.

**b. Inspection.** Inspect instrument panel wiring and connections. Repair wiring if necessary.

**c. Installation.** Refer to figure 3-30 and install gages and lights in instrument panel.

### 3-55. Battery Charging Receptacle and Hourmeter

**a. Removal.**

- (1) Place battery disconnect switch in disengaged position.
- (2) Refer to figure 3-31 and remove battery charging receptacle and hourmeter.

**b. Installation.** Refer to figure 3-31 and install the battery charging receptacle and hourmeter.

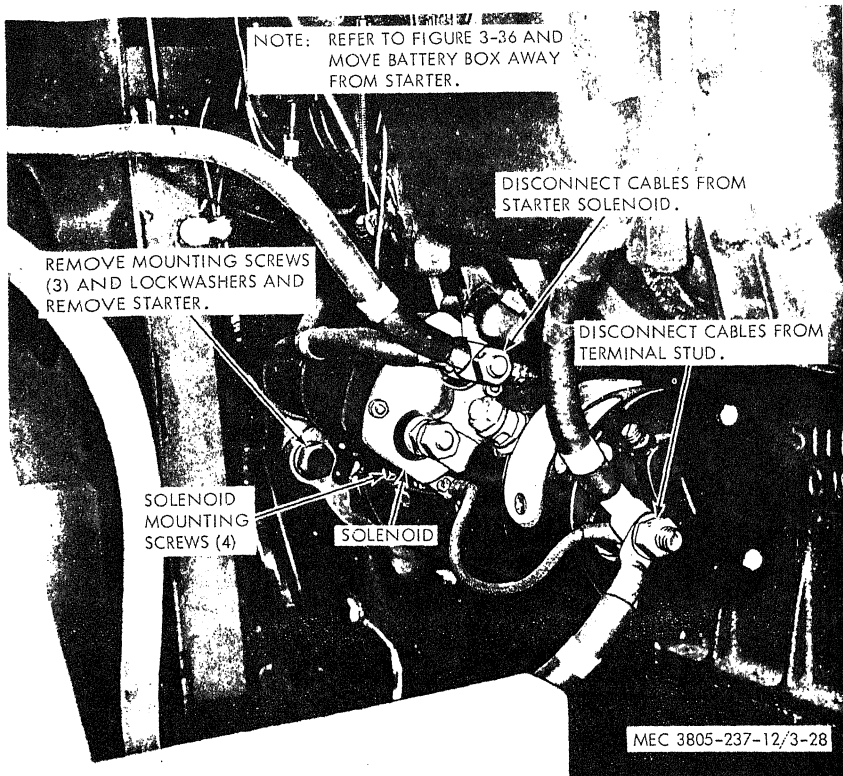


Figure 3-28. Starter, removal and installation.

### 3-56. Vehicle Lights

**Caution:** Do not attempt to service or remove any vehicle lights without placing the battery disconnect switch in the disengaged position.

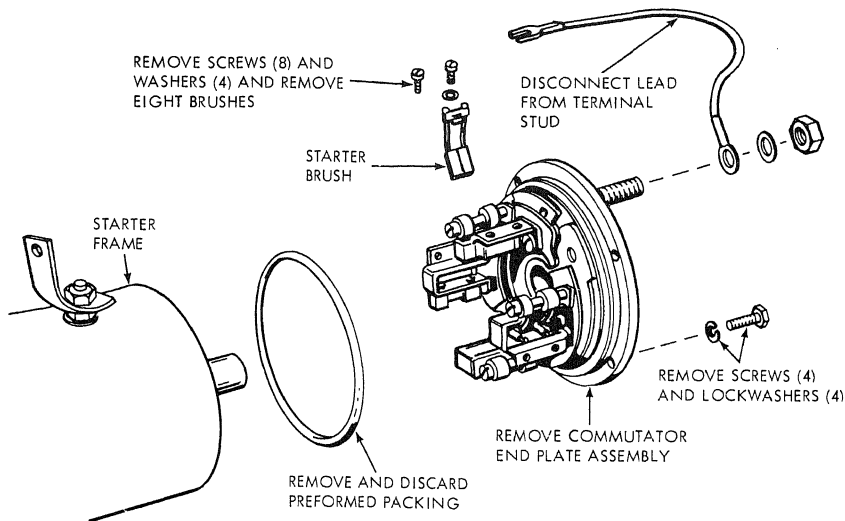
#### a. Floodlights.

- (1) *Removal.* Refer to figure 3-32 and remove the floodlight.
- (2) *Installation.* Refer to figure 3-32 and install the floodlight.

#### b. Headlights.

- (1) *Removal.* Refer to figure 3-33 and remove the headlights.
  - (2) *Installation.* Refer to figure 3-33 and install the headlights.
- c. *Blackout Light and Taillight.*
- (1) *Removal.* Refer to figure 3-34 and remove blackout light and taillight.
  - (2) *Installation.* Refer to figure 3-34 and install blackout light and taillight.





MEC 3805-237-12/3-29

Figure 3-29. Starter brushes, removal and installation.

### 3-57. Horn

*a. Removal.* Refer to figure 3-35 and remove the horn.

*b. Installation.* Refer to figure 3-35 and install the horn.

### 3-58. Batteries

*a. Service.*

- (1) *Specific gravity test.* The state of charge of each battery cell is determined by checking the specific gravity of the electrolyte (battery fluid). A corrected specific gravity reading of 1.285 in each cell indicates a fully charged battery. A reading of 1.225 or less in each cell indicates that the battery must be recharged or replaced.
- (2) *Adding water.* The water in the electrolyte solution will evaporate at

high temperature or with excessive charging rates. Check the electrolyte level and add distilled water or clean water when necessary to bring the electrolyte level the three-fourths of an inch above the separators.

- (3) *Cleaning.* The tops of the batteries must be kept clean. Tighten vent plugs and clean batteries with a brushed dipped in an alkaline solution such as ammonia or a solution of bicarbonate of soda and water. After foaming stops, flush top of batteries with clean water. If terminals and cable clamps are corroded, disconnect cables and clean with the same solution. Connect cables to battery. Waterproof battery terminals by packing with heavy asbestos grease (GK).

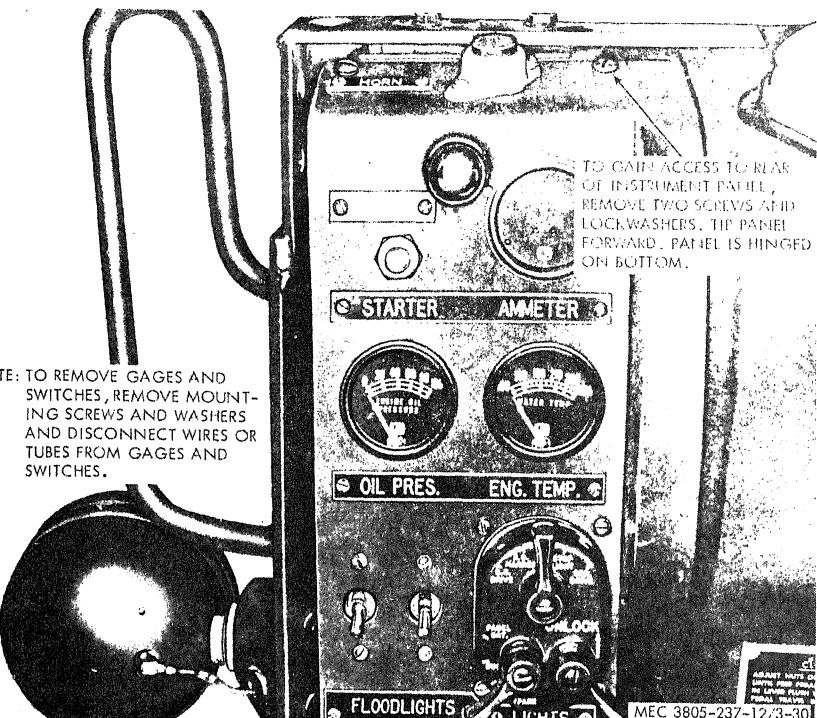


Figure 3-30. Gages and light, removal and installation.

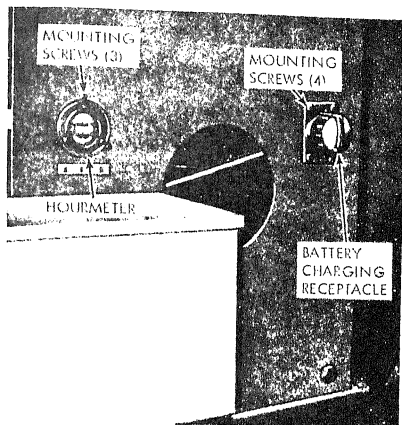
**Warning:** When removing battery cables, disconnect the ground cable first. When installing battery cables, connect the ground cable last. Accidental contact of a cable replacing tool with the vehicle causes a direct short resulting in arcing and instant heating of the tool to red heat. This can cause painful burns on hands and serious damage to tools, vehicle and batteries. A shorted battery may explode and

spray hot acid over the surrounding area.

*b. Removal.*

- (1) Place battery disconnect switch in disengaged position.
- (2) Refer to figure 3-36 and remove batteries.

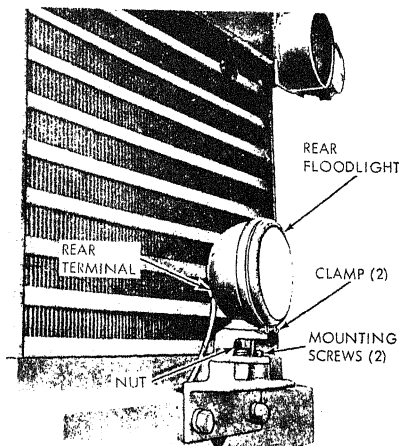
*c. Installation.* Refer to figure 3-36 and install the batteries.



- STEP 1. REMOVE THREE SCREWS, DISCONNECT WIRES AT REAR OF HOURMETER.
- STEP 2. REMOVE HOURMETER AND RESILIENT MOUNT.
- STEP 3. REMOVE FOUR SCREWS, LOCKWASHERS, AND NUTS.
- STEP 4. DISCONNECT WIRES AT REAR OF BATTERY CHARGING RECEPTACLE AND REMOVE RECEPTACLE.

MEC 3805-237-12/3-31

*Figure 3-31. Battery charging receptacle and hourmeter, removal and installation.*

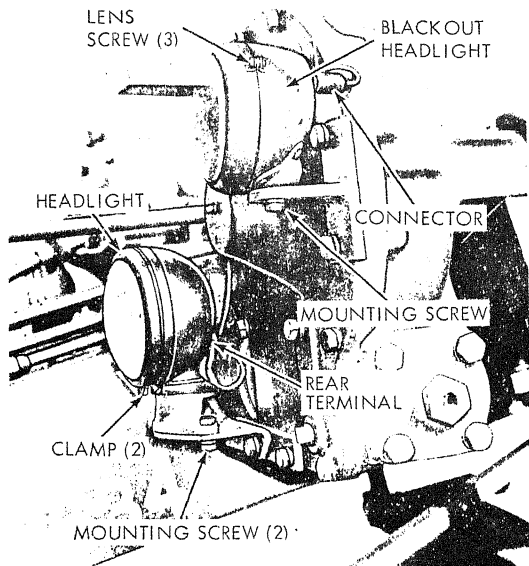


- STEP 1. DISCONNECT WIRE FROM REAR TERMINAL.
- STEP 2. REMOVE TWO MOUNTING SCREWS AND LOCKWASHERS.
- STEP 3. REMOVE FLOODLIGHT, REMOVE NUT AND REMOVE FLOODLIGHT FROM MOUNT.
- STEP 4. TO REPLACE LAMP UNIT IN FLOODLIGHT, REMOVE CLAMPS. REMOVE LAMP UNIT (SEALED BEAM) AND INSTALL NEW LAMP UNIT.

NOTE: FRONT AND REAR FLOODLIGHTS ARE SERVICED IN THE SAME MANNER.

MEC 3805-237-12/3-32

*Figure 3-32. Floodlight, removal and installation.*



#### BLACKOUT HEADLIGHT

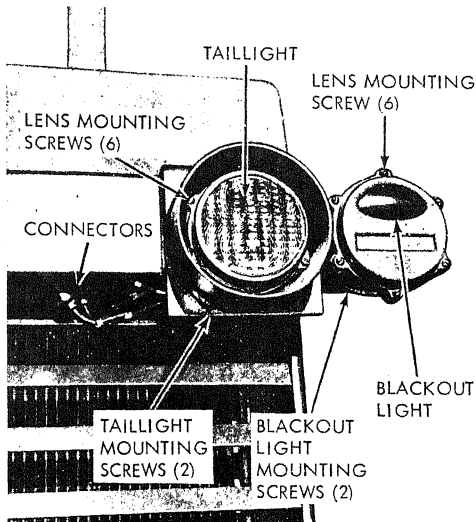
- STEP 1. DISCONNECT WIRE AT CONNECTOR.
- STEP 2. REMOVE MOUNTING SCREW AND REMOVE BLACKOUT HEADLIGHT.
- STEP 3. TO REPLACE LAMPS, REMOVE THREE LENS SCREWS. REMOVE LENS AND REMOVE LAMPS.

#### HEADLIGHT

- STEP 1. DISCONNECT WIRE FROM REAR TERMINAL.
- STEP 2. REMOVE TWO MOUNTING SCREWS, LOCKWASHERS, AND NUTS.
- STEP 3. REMOVE HEADLIGHT.
- STEP 4. TO REPLACE LAMP UNIT IN HEADLIGHT, REMOVE CLAMPS. REMOVE LAMP UNIT (SEALED BEAM) AND INSTALL NEW LAMP UNIT.

MEC 3805-237-12/3-33

Figure 3-33. Headlights, removal and installation.



#### BLACKOUT LIGHT

- STEP 1. DISCONNECT WIRE AT CONNECTOR AND PULL WIRE THROUGH GROMMET.
- STEP 2. REMOVE TWO MOUNTING SCREWS AND LOCKWASHERS AT REAR OF LIGHT AND REMOVE BLACKOUT LIGHT.
- STEP 3. TO REPLACE LAMPS IN BLACKOUT LIGHT, REMOVE SIX LENS MOUNTING SCREWS, REMOVE LENS, AND REMOVE LAMPS FROM SOCKETS.

#### TAILLIGHT

- STEP 1. DISCONNECT WIRE AT CONNECTOR.
- STEP 2. REMOVE TWO MOUNTING SCREWS AND LOCKWASHERS AT REAR OF TAILLIGHT AND REMOVE TAILLIGHT.
- STEP 3. TO REPLACE LAMPS IN TAILLIGHT, REMOVE SIX LENS MOUNTING SCREWS, REMOVE LENS, AND REMOVE LAMPS FROM SOCKETS.

MEC 3805-237-12/3-34

*Figure 3-34. Blackout light and taillight, removal and installation.*

## Section XII. TRANSMISSION ASSEMBLY

### 59. Transmission

*a. Inspection.* Inspect both transmissions for evidence of leaking or damage. Move shift levers through all gear ranges to check operation. Notify direct support maintenance if transmission is damaged or does not operate properly.

*b. Lubrication.* Check level of oil in transmission and fill to correct level if necessary.

## Section XIII. FRONT AXLE AND STEERING SYSTEM

### 60. Front Axle

*a. Service.* Perform lubrication of front axle as described in current lubrication order. Check condition of lubricating fittings and replace if damaged.

*b. Inspection.* Inspect front axle for damage. Inspect spindles and spindle forks for indications of wear. Inspect sleeve bearings on axle for wear and excessive movement pivot points in bearings. Notify direct support maintenance if parts require replacement.

### 61. Steering

*a. Inspection.* Inspect steering gear assembly for leakage and damage. Start engine and operate steering to check for proper operation. Inspect steering wheel and control shaft for damage and proper operation. Lubricate shaft if required. Refer to current lubrication order.

*b. Steering Arm.*

#### (1) Removal.

- (a) Turn moldboard straight across under frame. Lower moldboard until wheels leave the ground. Place blocks or jacks beneath axle to help support grader.
- (b) Scribe a mark on the power steering shaft and on steering arm to aid in correct location at assembly.
- (c) Refer to figure 3-38 and remove steering arm.

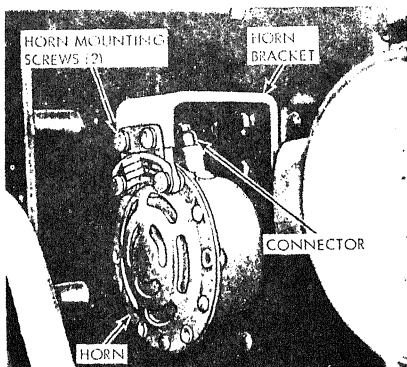
#### (2) Installation.

- (a) Align scribe marks on steering arm and power steering shaft.
- (b) Refer to figure 3-38 and install steering arm.

### 3-60. Transmission Levers

*a. Removal.* Refer to figure 3-37 and remove the transmission levers. Protect openings in transmission while levers are removed to prevent dirt or debris from entering transmission.

*b. Installation.* Refer to figure 3-37 and install transmission levers.



- STEP 1. DISCONNECT WIRES AT CONNECTOR.  
STEP 2. REMOVE TWO HORN MOUNTING SCREWS, LOCKWASHERS, AND NUTS.  
STEP 3. REMOVE HORN FROM HORN BRACKET.

MEC 3805-237-12/3-35

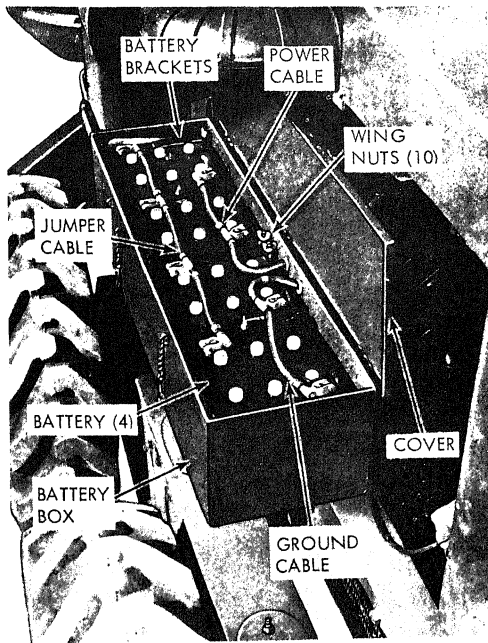
Figure 3-35. Horn, removal and installation.

*c. Steering Wheel and Shaft.*

#### (1) Removal.

- (a) Refer to figure 3-39 and remove the steering wheel.
- (b) Refer to figure 3-40 and remove steering wheel shaft.

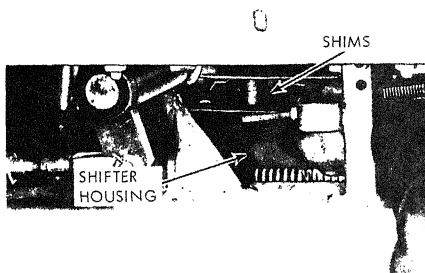
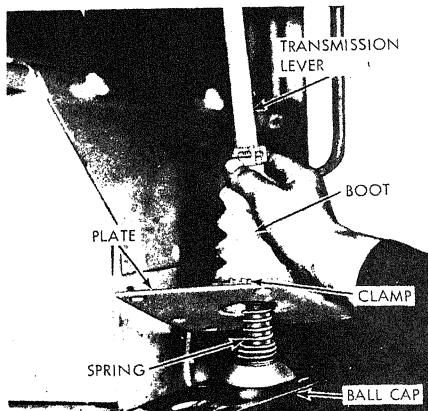
#### (2) Installation.



- STEP 1. OPEN BATTERY BOX COVER.
- STEP 2. LIFT LEVERS AND DISCONNECT GROUND CABLE. DISCONNECT GROUND CABLE FROM BATTERY DISCONNECT SWITCH UNDER OPERATOR'S CAB. REMOVE CABLE.
- STEP 3. DISCONNECT AND REMOVE JUMPER CABLE.
- STEP 4. DISCONNECT POWER CABLE FROM BATTERIES AND STARTER SOLENOID AND REMOVE CABLE.
- STEP 5. LOOSEN 10 WING NUTS AND REMOVE BATTERY HOLDDOWN BRACKETS.
- STEP 6. REMOVE FOUR BATTERIES FROM BATTERY BOX.
- STEP 7. REMOVE FOUR SCREWS AND WASHERS AT BOTTOM OF BATTERY BOX AND REMOVE BATTERY BOX.

MEC 3805-237-12/3-36

Figure 3-36. Batteries, removal and installation.

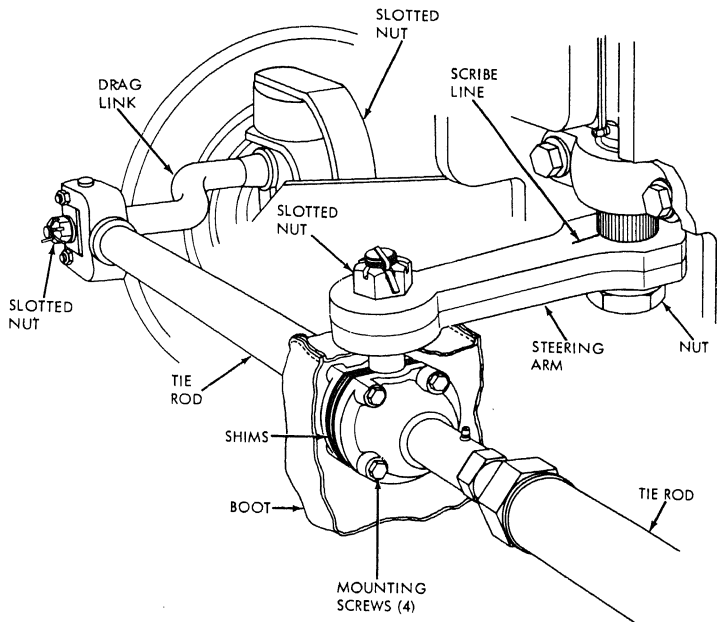


- STEP 1. REMOVE FIVE CARRIAGE BOLTS, LOCK-WASHERS, AND NUTS AND LIFT PLATE FROM FLOOR OF OPERATOR'S COMPARTMENT.
- STEP 2. REMOVE CLAMPS AND REMOVE RUBBER COVER FROM LEVERS AND SHIFTER HOUSING.
- STEP 3. REMOVE FOUR SCREWS AND LOCK-WASHERS SECURING BALL CAP TO SHIFTER HOUSING.
- STEP 4. REMOVE TRANSMISSION LEVER UP THROUGH FLOOR. REMOVE SHIMS.
- STEP 5. REMOVE CLAMPS AND REMOVE BOOT FROM LEVER.
- STEP 6. REMOVE SPRING, SEAL, AND BALL CAP FROM LEVER.

MEC 3805-237-12/3-37

*Figure 3-37. Transmission levers. removal and installation.*





#### A. STEERING ARM

- STEP 1. SCRIBE A LINE ON STEERING ARM AND SPLINED STEERING SHAFT.
- STEP 2. REMOVE LACES AND REMOVE BOOT.
- STEP 3. REMOVE FOUR SCREWS, LOCKWASHERS, AND NUTS SECURING TIE RODS TO STEERING ARM. REMOVE AND COUNT NUMBER OF SHIMS.
- STEP 4. REMOVE NUT AND LOCKWASHER SECURING STEERING ARM TO STEERING SHAFT AND REMOVE STEERING ARM.

#### B. TIE RODS

- STEP 1. REMOVE LACES AND REMOVE BOOT.
- STEP 2. REMOVE FOUR SCREWS, LOCKWASHERS, AND NUTS SECURING TIE RODS TO STEERING ARM. REMOVE AND COUNT NUMBER OF SHIMS.
- STEP 3. REMOVE COTTER PIN AND SLOTTED NUT SECURING TIE ROD TO DRAG LINK.
- STEP 4. REMOVE TIE ROD.

NOTE: WHEN INSTALLING TIE RODS ON STEERING ARM BALL, INSTALL CORRECT AMOUNT OF SHIMS TO PROVIDE A FREE, BUT SNUG, FIT.

#### C. DRAG LINK

- STEP 1. REMOVE COTTER PIN AND SLOTTED NUT FROM BOTH ENDS OF DRAG LINK.
- STEP 2. REMOVE DRAG LINK FROM TIE ROD AND SPINDLE.

MEC 3805-237-12/3-38

Figure 3-38. Steering arm, tie rods, and drag links, removal and installation.

- (a) Refer to figure 3-40 and install the steering wheel shaft.
- (b) Refer to figure 3-39 and install the steering wheel.

#### d. Tie Rods and Drag Links.

##### (1) Removal.

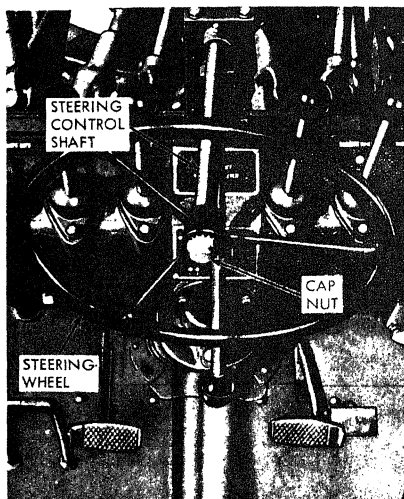
- (a) Refer to figure 3-38 and remove tie rods from steering arm.
- (b) Refer to figure 3-38 and remove drag links.

##### (2) Installation.

- (a) Refer to figure 3-38 and install the drag links.
- (b) Refer to figure 3-38 and install the tie rods. Refer to paragraph 3-63d and adjust wheel toe-in.

### 3-63. Wheel Adjustment

#### a. General. Wheel alignment and steering



- STEP 1. REMOVE CAP NUT AND LOCKWASHER.  
STEP 2. USING A SUITABLE PULLER, REMOVE STEERING WHEEL FROM STEERING CONTROL SHAFT.

MEC 3805-237-12/3-39

Figure 3-39. Steering wheel, removal and installation.

performance is based on wheel camber, wheel caster and wheel toe-in.

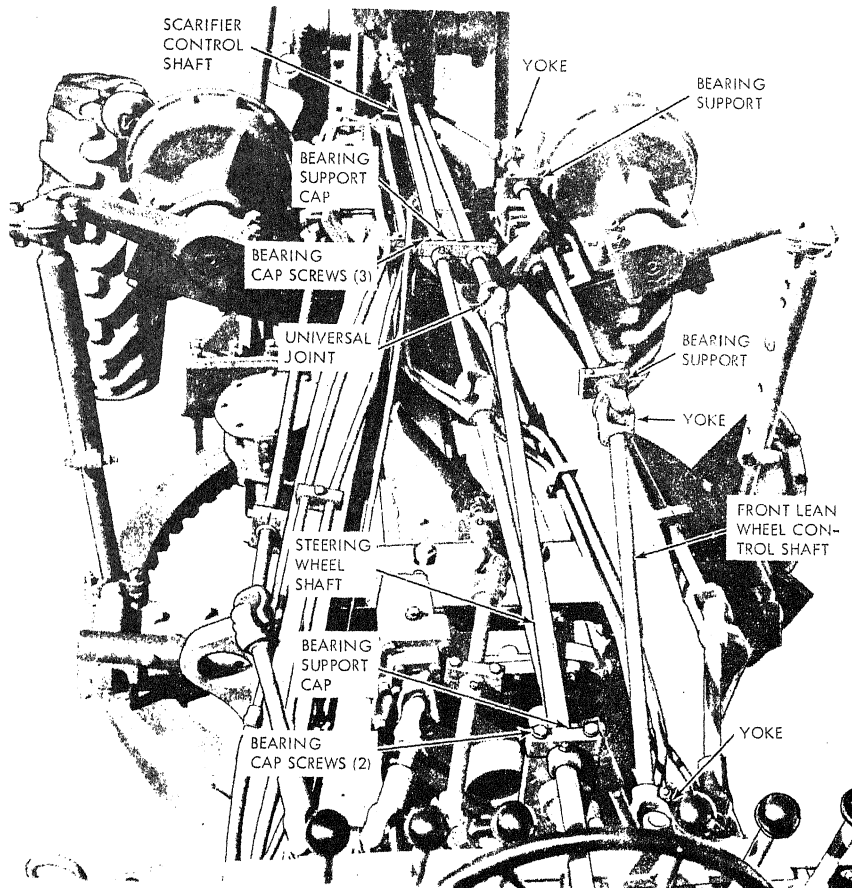
- (1) *Wheel camber.* Camber means the wheels are closer together at bottom than at the top. This positive camber offsets wear in axle parts, spindle bearings, sleeve bearings and wheel bearings. This wear is caused by sagging and wheel deflection.
- (2) *Wheel caster.* Caster defines the placement of the spindle forks. Positive caster means the top of the spindle fork is closer to the rear of the machine than the bottom. Caster, along with toe-in and camber centers the weight of the machine on center of tires and splines.
- (3) *Toe-in.* Toe-in of wheels means the front of the tires are closer to the machine than the rear of the tires. A leaning wheel tries to turn outward and toe-in overcomes this tendency and reduces drag and wear on tires.

b. *Wheel Caster Adjustment.* Caster adjustment is built into the machine and cannot be adjusted by relation of the axle pivot pin to front bolster. Replaceable bearings are provided at these points and should be replaced if badly worn. Ease of steering is not affected by small changes in caster. Notify direct support maintenance if axle pivot pin and front bolster bearings require replacement.

##### c. Wheel Camber Adjustment.

*Note.* Before attempting to correct camber or toe-in, check spindles and spindle forks to determine if bearings or sleeve bearings require replacement. Notify direct support maintenance if bearings have to be replaced.

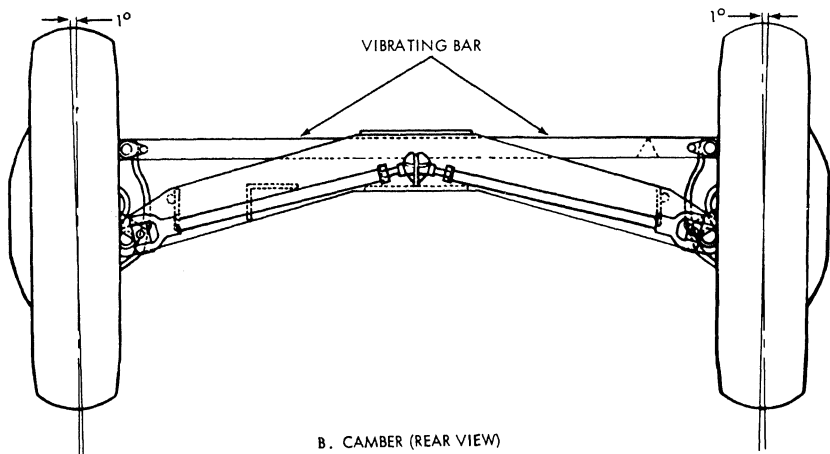
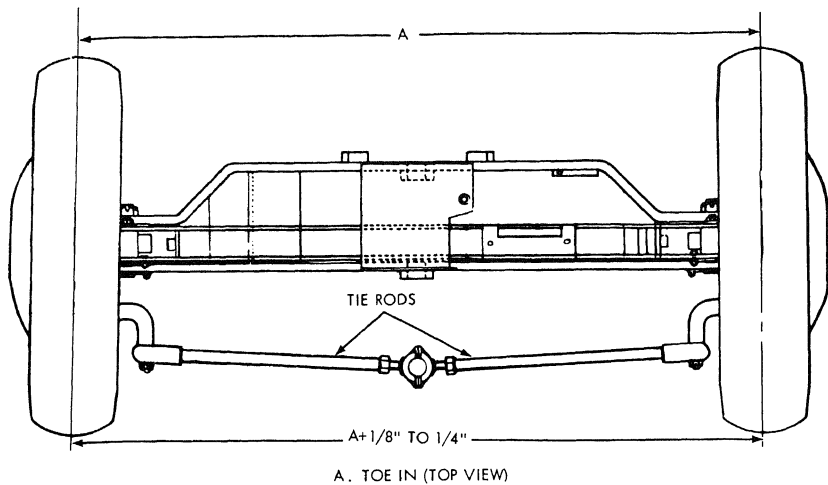
- (1) Camber must be one degree of positive camber on each wheel; top of wheel must lean outward.
- (2) Refer to figure 3-41 for wheel camber and toe-in adjustment. These settings are shown with weight of grader on wheels.
- (3) Operate leaning wheel control so that one wheel leans outward one degree. Opposite wheel must lean outward the same.
- (4) Notify direct support maintenance to repair or replace spindle forks, front axle, vibrating link, or bearings as



- STEP 1. REMOVE TWO SCREWS AND LOCKWASHERS AND REMOVE REAR BEARING SUPPORT CAP.
- STEP 2. REMOVE THREE SCREWS AND LOCKWASHERS AND REMOVE FRONT BEARING SUPPORT CAP.
- STEP 3. REMOVE COTTER PIN AND STRAIGHT PIN AND DISCONNECT SHAFT AT UNIVERSAL JOINT.
- STEP 4. REMOVE COTTER PIN AND STRAIGHT PIN AND DISCONNECT SHAFT FROM STEERING GEAR AT FRONT OF MOTOR GRADER.

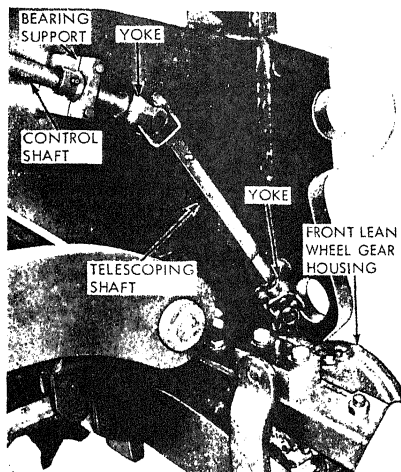
MEC 3805-237-12/3-40

Figure 3-40. Steering wheel shaft, removal and installation.



MEC 3805-237-12/3-41

Figure 3-41. Wheels camber and toe-in adjustment.



- STEP 1. REMOVE FOUR SCREWS AND LOCK-WASHERS AND REMOVE CAPS FROM TWO BEARING SUPPORTS (FIG. 3-41) SUPPORTING FRONT LEAN WHEEL CONTROL SHAFT.
- STEP 2. REMOVE SCREWS, NUTS, AND PINS AND DISCONNECT THREE YOKES (FIG. 3-41) FROM CONTROL SHAFT AND POWER CONTROL BOX.
- STEP 3. REMOVE TWO SCREWS AND LOCK-WASHERS AND REMOVE CAP FROM BEARING SUPPORT.
- STEP 4. REMOVE SCREWS AND NUTS AND DISCONNECT YOKES FROM CONTROL SHAFT AND FRONT LEAN WHEEL GEAR HOUSING.

MEC 3805-237-12/3-42

Figure 3-42. Front leaning wheel control shaft, removal and installation.

necessary to correct camber, if required.

#### d. Wheel Toe-In Adjustment.

- (1) Lower moldboard to ground far enough to raise front wheels.
- (2) Hold a piece of chalk at the center of each front tire and rotate wheel to place a chalk mark all around tire.
- (3) Lower wheels to ground. Loosen locking nuts and adjust length of each tie rod until distance (A, fig. 3-41) between chalk line is  $\frac{1}{8}$  to  $\frac{1}{4}$  inch longer at rear of tire than at front of tire. Tighten tie rod locking nut.

### 3-64. Front Leaning Wheel Assembly

a. *Gear Assembly.* Inspect gear assembly for leaks and damage. Notify direct support maintenance if gear assembly requires replacement. Fill gear housing with correct lubricant, if necessary. Refer to current lubrication order.

b. *Vibration Bar and Gear Rack.* Inspect vibrating bar, vibrating link, and gear rack for damage. Operate leaning wheel controls and check operation. Operation should be smooth and positive. Notify direct support maintenance if repair or replacement is required.

#### c. Front Leaning Wheel Control Shaft.

- (1) *Removal.* Refer to figure 3-42 and remove front leaning wheel control shaft.
- (2) *Installation.* Refer to figure 3-42 and install front leaning wheel control shaft.

## Section XIV. TANDEM DRIVES AND BRAKES

### 3-65. Tandem Drives

a. *General.* The two tandem drives operate both rear wheels. The lower transmission and final drive rotate the driving sprocket at the center of the tandem drive. Front and rear driving axles are driven by chains from the

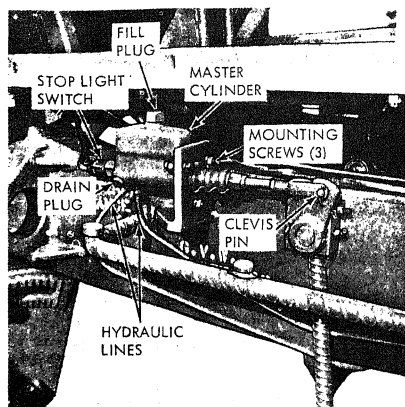
driving sprocket. The four rear wheels drive the motor grader and the two front tandem wheels are equipped with service brakes.

b. *Inspection.* Inspect tandem drives for leaks and damage. Remove upper covers and inspect chains and sprockets for wear. Notify direct support maintenance if repair or replace-

ment of tandem drive components is required.

### 3-66. Brake System

a. *General.* The service brakes on the motor grader are hydraulically actuated. Pressure on the brake pedal actuates the master cylinder. Hydraulic pressure from the master cylinder, through the hydraulic brake lines, actuates the wheel cylinders. The wheel cylinders force the brake linings against the brake drums, stopping the grader. The parking brake is actuated by pulling the parking brake lever in



- STEP 1. DISCONNECT STOP LIGHT SWITCH FROM MASTER CYLINDER.
- STEP 2. DRAIN MASTER CYLINDER.
- STEP 3. DISCONNECT HYDRAULIC LINES FROM MASTER CYLINDER.
- STEP 4. REMOVE COTTER PIN AND REMOVE CLEVIS PIN FROM CLEVIS AND LEVER.
- STEP 5. REMOVE THREE MOUNTING SCREWS, LOCKWASHERS, AND NUTS AND REMOVE MASTER CYLINDER.

NOTE: AFTER INSTALLATION OF MASTER CYLINDER AND REPLACING HYDRAULIC FLUID, BLEED HYDRAULIC SYSTEM BEFORE OPERATING MOTOR GRADER.

MEC 3805-237-12/3-43

Figure 3-43. Brake master cylinder, removal and installation.

the operator's compartment. This action will set the parking brake and hold the motor grader in position while parked.

#### b. Master Cylinder.

- (1) *Removal.* Refer to figure 3-43 and remove the master cylinder and hydraulic lines.
- (2) *Installation.* Refer to figure 3-43 and install the brake master cylinder.
- (3) *Bleed brake system.*
  - (a) Fill master cylinder with brake fluid (fig. 3-2).
  - (b) Refer to figure 3-44 and bleed both front tandem wheels to bleed the brake system.

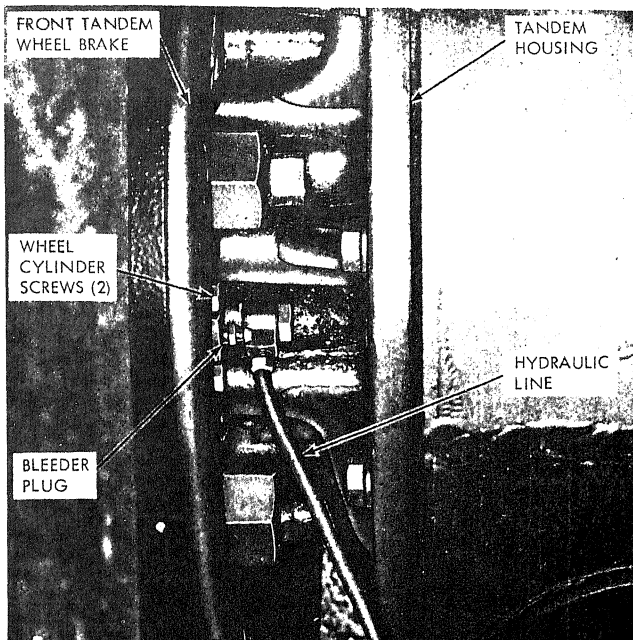
#### c. Wheel Cylinders.

- (1) *Removal.*
  - (a) Remove wheel and brake drum from grader (para 3-67).
  - (b) Disconnect hydraulic line (fig. 3-44) from wheel cylinder fitting.
  - (c) Remove two wheel cylinder screws (fig. 3-44) and lockwashers.
  - (d) Remove wheel cylinder and links from brake assembly.
- (2) *Installation.*
  - (a) Install links in wheel cylinder. Move shoes outward to permit installation of cylinder between brake shoes. Slots in links must be installed over edge of brake shoes.
  - (b) Secure wheel cylinder with two screws (fig. 3-44) and lockwashers.
  - (c) Connect hydraulic line (fig. 3-44) to wheel cylinder fitting.
  - (d) Install wheel and brake drum on grader (para 3-67).
  - (e) Bleed the brake hydraulic system (fig. 3-44).

d. *Parking Brake.* The parking brake is mounted on the lower transmission assembly countershaft. A hand lever, mounted in the operator's compartment, sets the parking brake, through a linkage, when the vehicle is parked. Adjust parking brake linkage as follows:

- (1) Refer to figure 3-45 and adjust parking brake linkage.
- (2) Operate hand lever and check function of linkage and brake.

e. *Wheel Brake Adjustment.* The motor grader wheel brakes have an automatic ad-

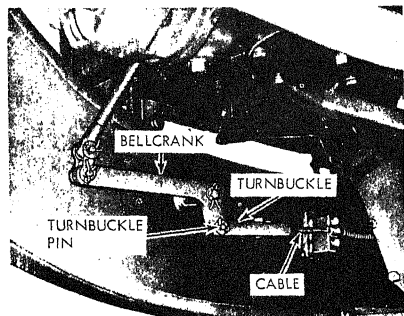


- STEP 1. CONNECT TUBE TO BLEEDER PLUG FITTING. ALLOW TUBE TO HANG INTO RECEPTACLE SUCH AS A CLEAN GLASS JAR.
- STEP 2. REMOVE MASTER CYLINDER FILL PLUG (FIG. 3-43) AND KEEP CYLINDER FILLED WITH FLUID WHILE BLEEDING LINES.
- STEP 3. OPEN BLEEDER PLUG 3/4 TURN.
- STEP 4. DEPRESS BRAKE PEDAL (FIG. 2-2) HALF WAY; CLOSE BLEEDER PLUG AND RELEASE BRAKE PEDAL.
- STEP 5. REPEAT STEPS 3 AND 4 TO FORCE FLUID OUT OF SYSTEM. KEEP END OF TUBE BELOW SURFACE OF FLUID IN JAR.
- STEP 6. WHEN ALL AIR BUBBLES CEASE TO APPEAR IN JAR, CLOSE BLEEDER PLUG AND REMOVE TUBE.

NOTE: REPEAT BLEEDING OPERATION AT BRAKE ON OTHER SIDE OF GRADER.

MEC 3805-237-12, 3-44

Figure 3-44. Bleeding brake hydraulic system.



- STEP 1. REMOVE COTTER PIN AND REMOVE TURNBUCKLE PIN AND WASHERS.
- STEP 2. SHORTEN OR LENGTHEN CABLE BY ROTATING TURNBUCKLE UNTIL PARKING BRAKE IS APPLIED WHEN PARKING BRAKE LEVER (FIG. 2-2) REACHES HALF THE LENGTH OF TRAVEL.
- STEP 3. CONNECT TURNBUCKLE TO BELL-CRANK AND SECURE WITH TURNBUCKLE PIN, WASHERS, AND COTTER PIN.

MEC 3805-237-12/3-45

Figure 3-45. Parking brake linkage adjustment.

justment built into the brake assembly. Through a cable and spring arrangement the brake adjusting screw is rotated to adjust the brake shoes as they wear. Initial brake adjustment must be made when new linings are installed. If brake linings require replacement, notify direct support maintenance. To obtain automatic adjustment, move grader in reverse a short distance and apply brakes. Repeat procedure two or three times.

*f. Brake Pedal and Linkage.*

- (1) *Removal.* Refer to figure 3-46 and remove the brake pedal and linkage.
- (2) *Installation.* Refer to figure 3-46 and install brake pedal and linkage.
- (3) *Adjustment.* Refer to figure 3-46 and adjust brake pedal linkage as follows.

- (a) With brake pedal seal pad (10) against floor plate, remove cotter pin and remove pin (2).
- (b) Loosen locknuts (4) and adjust length of threaded rod (5) until holes in clevis (3) are 1/32 to 1/16 inch too short to align with hole in lever (1).
- (c) Pull rod to align holes and install pin (2) in clevis and lever and secure with cotter pin.
- (d) Depress brake pedal (7) and release several times.
- (e) Remove cotter pin and remove pin (2) from clevis (3) and lever (1).
- (f) Check distance detailed in (b) above. If distance hasn't changed, install pin (2) and secure with cotter pin. If necessary, repeat adjustment procedure.

### 3-67. Wheels and Tires

*a. Wheels.*

(1) *Removal.*

*Note.* All six wheels on the motor grader are mounted the same. The only difference in the wheels are the brake drums on the two front tandem wheels.

- (a) Jack or raise frame or axle of motor grader to elevate wheels from ground.
- (b) Refer to figure 3-47 and remove wheel and tire from grader.

(2) *Installation.*

- (a) Refer to figure 3-47 and install wheel and tire on grader.
- (b) Lower motor grader to ground.

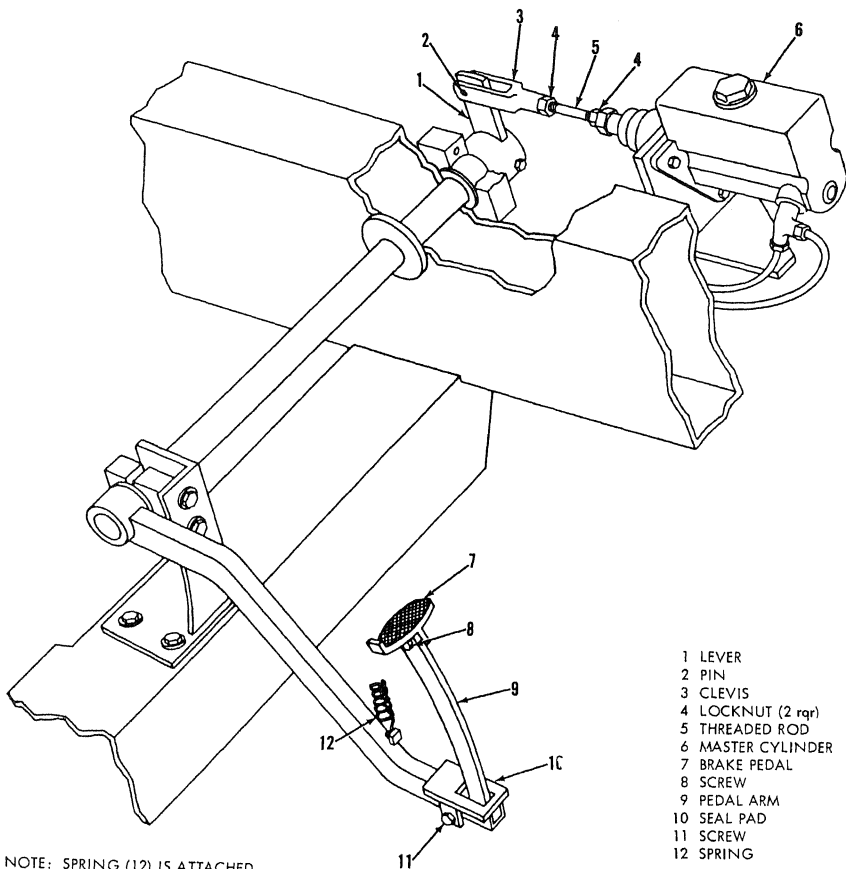
*b. Tires.* The tires on the motor grader are of the tubeless type.

**Warning:** Care must be observed to install a protective device or chain around tire before attempting to inflate tire.

(1) *Removal.*

- (a) Remove wheel (a above).
- (b) Rest wheel on a support to keep wheel off ground.
- (c) Deflate tire by removing valve core.
- (d) Use a hammer and a pry bar to loosen locking.
- (e) Remove preformed packing from wheel.



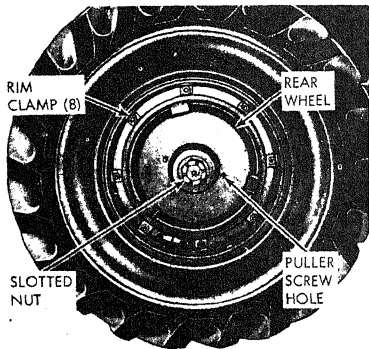


MEC 3805-237-12/3-46

Figure 3-46. Brake pedal and linkage adjustment, removal and replacement.

- (f) Remove large flange from wheel.  
Remove tubeless tire from rim.
- (g) Remove valve from wheel rim.
- (2) Installation.
  - (a) Install valve in wheel rim.
  - (b) Install tire on wheel.
  - (c) Install flange on rim. Depress flange and install preformed packing in lower groove in rim base.
  - (d) Install lockring in base. Start one

1300 × 24 10-ply tires, inflate to 30 pounds.



## Section XV. HYDRAULIC SYSTEM

### 3-68. Hydraulic Reservoir

- a. *Inspection.* Inspect hydraulic reservoir and lines for leakage and damage. Replace any defective lines. Notify direct support maintenance if reservoir requires replacement.
- b. *Reservoir Cap.* Remove cap and check cap for secure fit and for damage. Inspect gage for damage. Replace defective parts.
- c. *Hydraulic Reservoir Filter.* Refer to paragraph 3-4 for service of the filter.

### 3-69. Steering Hydraulic Pump

- a. *General.* The hydraulic pump is mounted on the front of the power box and is driven by the power box vertical drive shaft.
- b. *Removal.* Refer to figure 3-48 and remove hydraulic pump.
- c. *Installation.* Refer to figure 3-48 and install hydraulic pump.

## Section XVI. HOOD AND CAB ASSEMBLY

### 3-70. Engine Hood

- a. *Removal.* Refer to figure 3-21 and remove engine hood.
- b. *Installation.* Refer to figure 3-21 and install engine hood and panels.

### 3-71. Cab

- a. *Removal.* Refer to figure 2-2 and remove seat and cab components.
- b. *Installation.* Refer to figure 2-2 and install seat and cab components.

### 3-72. Tool Box

- a. *Removal.*
  - (1) Open tool box and remove tools.
  - (2) Remove four screws and washers securing tool box to brackets and remove tool box.
- b. *Installation.*
  - (1) Install tool box on right rear brackets alongside of engine and secure with four screws and washers.
  - (2) Place tools in tool box and secure cover.

STEP 1. REMOVE EIGHT NUTS AND RIM CLAMPS.

STEP 2. REMOVE COTTER PIN AND REMOVE SLOTTED NUT FROM AXLE.

NOTE: ON FRONT WHEELS, REMOVE THREE SCREWS AND LOCKWASHERS AND REMOVE HUB CAP. REMOVE SCREW AND LOCK NUT AND REMOVE WHEEL NUT FROM AXLE.

STEP 3. INSTALL TWO 7/8-9 PULLER SCREWS IN PULLER SCREW HOLES ATTACHING SUIABLE PULLER. TURN PULLER SCREW IN AGAINST END OF AXLE UNTIL WHEEL IS FREE.

NOTE: FRONT WHEELS CAN BE REMOVED WITHOUT USE OF PULLER SCREWS.

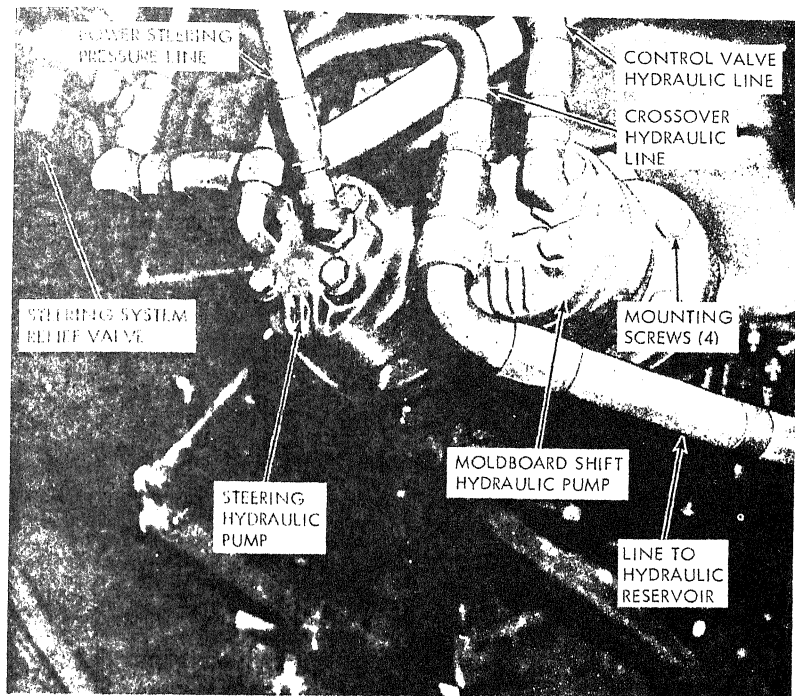
MEC 3805-237-12/3-47

Figure 3-47. Wheels, removal and installation.

end of locking in upper groove of rim. Work ring into place gradually until it is firmly locked.

#### (3) Inflation.

- (a) Install protective device or chain on tire.
- (b) Inflate tire with enough air pressure to seat tire solidly on rim and flange.
- (c) After tire is seated and sealed, reduce pressure to normal limits. On Model 440HA motor graders with



- STEP 1. DISCONNECT HYDRAULIC LINES FROM PUMP.  
 STEP 2. REMOVE FOUR MOUNTING SCREWS AND LOCKWASHERS.  
 STEP 3. REMOVE PUMP AND ADAPTER FROM VERTICAL DRIVE HOUSING, REMOVE GASKET.  
 STEP 4. REMOVE FITTINGS FROM PUMP.

NOTE: REMOVAL IS IDENTICAL FOR BOTH HYDRAULIC PUMPS.  
 INSTALL NEW GASKET WHEN INSTALLING PUMP.

MEC 3805-237-12/3-48

*Figure 3-48. Hydraulic pump, removal and installation.*

## Section XVII. POWER CONTROL BOX

### 3-73. Control Box

a. *Inspection.* Inspect control box for leak-

age and damage. Operate controls and check operation of control box. All controls should

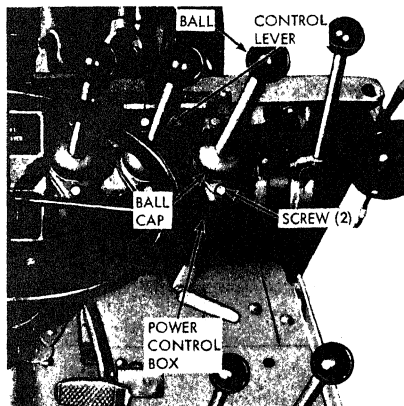
shift smoothly and response to control should be immediate. Notify direct support maintenance if control box is defective.

b. *Service.* Replenish oil in control box if necessary. Refer to current lubrication order.

### 3-74. Control Box Levers

a. *Removal.* Refer to figure 3-49 and remove control box levers.

*Note.* All control box levers are removed in the same manner.



STEP 1. REMOVE BALL FROM TOP OF LEVER.  
STEP 2. REMOVE TWO SCREWS AND LOCKWASHERS.

STEP 3. REMOVE CONTROL LEVER AND BALL CAP FROM POWER CONTROL BOX.

STEP 4. COUNT AND REMOVE SHIMS BETWEEN BALL CAP AND CONTROL BOX.

STEP 5. REMOVE BALL CAP AND BALL SEAT FROM LEVER.

NOTE: ALL CONTROL LEVERS ARE REMOVED IN THE SAME MANNER.

MEC 3805-237-12/3-49

Figure 3-49. Control box levers, removal and installation.

b. *Installation.* Refer to figure 3-49 and install the control box levers.

### 3-75. Propeller Shaft

a. *Removal.* Refer to figure 3-50 and remove propeller shaft.

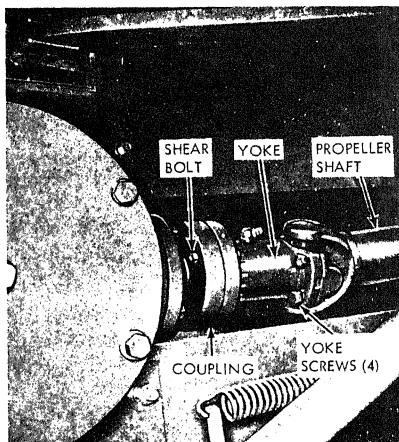
*Note.* The propeller shaft has a shear bolt coupling. Refer to figure 3-50 for replacement of the shear bolt.

b. *Installation.* Refer to figure 3-50 and install propeller shaft.

### 3-76. Clutch Anti-Coast Brakes

a. *General.* Each power box clutch that drives a control shaft is equipped with an anti-coast brake. This brake prevents coasting of moldboard, scarifier, circle reverse and lateral shift when a load is placed on it.

*Note.* Before adjusting the clutch anti-coast brake, adjust the worm gear end thrust bearing in the gear housings (para 3-85).



STEP 1. REMOVE NUT AND TWO LOCKWASHERS AND REMOVE SHEAR BOLT FROM COUPLING.

STEP 2. REMOVE FOUR YOKE SCREWS AND LOCK PLATE AND REMOVE YOKE FROM PROPELLER SHAFT.

STEP 3. REMOVE YOE SCREWS AND DISCONNECT PROPELLER SHAFT FROM TRANSMISSION.

MEC 3805-237-12/3-50

Figure 3-50. Propeller shaft and shear bolt, removal and installation.

- (1) Adjust brake by tightening adjusting nut (fig. 3-51) on particular brake until coasting is eliminated. Take up on adjustment and check operation. It may be necessary to vary the ad-

justment to get the best results.

- (2) If adjustment does not correct operation, notify direct support maintenance.

## Section XVIII. MOLDBOARD

### 3-77. Moldboard Blade

#### a. Removal.

- (1) Lift moldboard from ground and support blade.
- (2) Refer to figure 3-52 and remove moldboard blade and edges.

b. *Installation.* Refer to figure 3-52 and install moldboard blade and edges.

### 3-78. Power Shift Moldboard

a. *General.* Hydraulic oil pressure in a cylinder moves the moldboard to either side. A separate hydraulic pump supplies pressure for the power shaft.

b. *Inspection.* Inspect hydraulic cylinder (fig. 3-52) and lines for leakage and damage. Replace damaged lines. Inspect slides and clean and lubricate. Refer to current lubrication order.

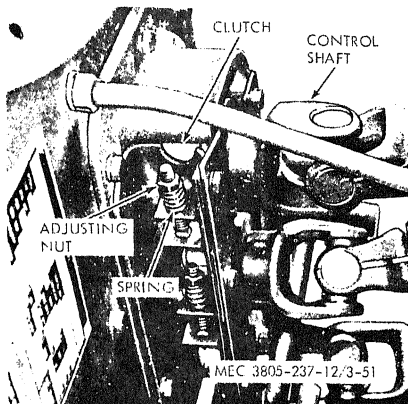


Figure 3-51. Clutch anti-coast brake adjustment.

## Section XIX. CIRCLE REVERSE MECHANISM

### 3-79. Lateral Shift and Lift Gear Assemblies

a. *Inspection.* Inspect gear assemblies for leakage and damage. Check control shaft and universal joints for looseness. Inspect pins in left and lateral shift links for wear and damage. Operate lateral shift and lift controls and check operation. Tilt and lift blade to check movement of circle and drawbar pivot.

b. *Adjustment.* If ball and sockets are loose, adjust as follows.

- (1) Lower moldboard to the ground.
- (2) Remove shims in lift links as shown in figure 3-53.
- (3) Remove shims from lateral shift link as shown in figure 3-54.

### 3-80. Circle Reverse Assembly

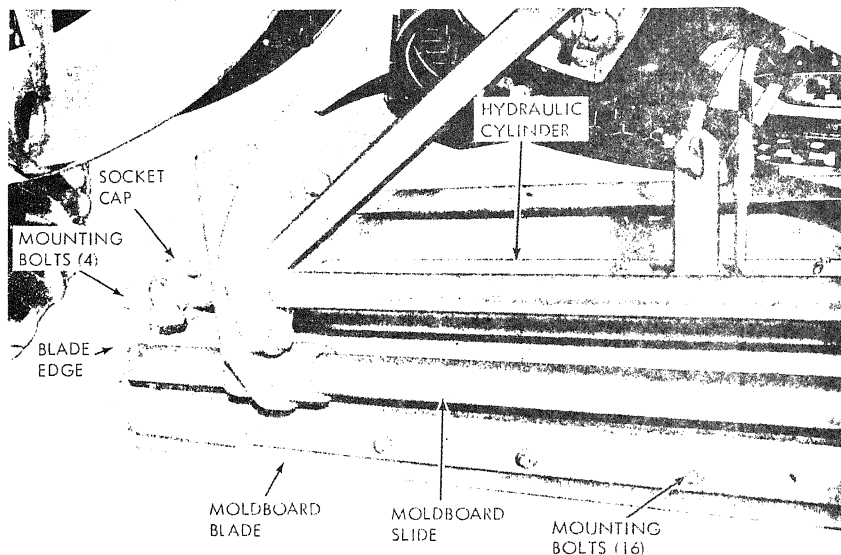
a. *Gear Assembly.* Inspect gear assembly for leakage and damage. Inspect large circle reverse gear for damaged teeth. Operate con-

trols and move circle reverse through entire length of travel. Check operation of gear assembly and reversing pinion. Check retaining plates and shims at three points of suspension on drawbar. If plates need adjustment, notify direct support maintenance.

b. *Reversing Pinion.* Check reversing pinion clearance with circle gear. Note any wear spots on circle gear teeth. Wear should be even all around circle. If wear shows in certain areas, circle is out of alignment and three retaining plates and shims must be adjusted to align circle with reversing pinion.

### 3-81. Drawbar

a. *General.* The drawbar supports the circle, moldboard and reversing gear assembly. A ball at the front end of the drawbar pivots in the front of the main frame, allowing the circle and moldboard to be raised to



- STEP 1. REMOVE FOUR MOUNTING BOLTS AND FOUR SCREWS FROM BOTH ENDS OF MOLDBOARD AND REMOVE TWO BLADE EDGES.
- STEP 2. REMOVE 16 MOUNTING BOLTS AND NUTS AND REMOVE TWO MOLDBOARD BLADES AND TWO BOOTS.

MEC 3805-237-12/3-52

*Figure 3-52. Moldboard blade, removal and installation.*

the sides of the frame and to change the blade angle for all types of operations.

*b. Inspection.* Check drawbar and circle

mountings for damage. Operate circle and check drawbar pivot in frame. If drawbar ball is loose in frame, notify direct support maintenance.

## Section XX. SCARIFIER

### 3-82. Scarifier Gear Assembly

*a. Inspection.* Inspect scarifier gear assembly for leakage and damage. Check universal joints and shaft connections for looseness and damage. Operate scarifier controls and check operation. Move scarifier up and down as necessary to check controls. If gear assembly is defective, notify direct support maintenance.

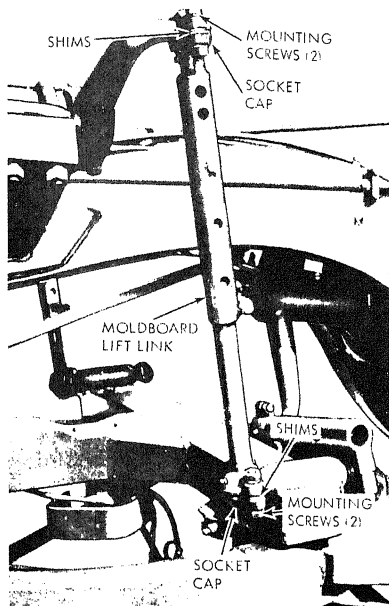
*b. Service.* Lubricate gear assembly as

necessary. Refer to the current lubrication order. Adjust end thrust bearing (para 3-85) if necessary.

### 3-83. Scarifier Lift Arms

*a. Removal.* Refer to figure 3-55 and remove scarifier lift arms.

*b. Installation.* Refer to figure 3-55 and install scarifier lift arms.



- STEP 1. REMOVE TWO SCREWS, LOCKWASHERS, AND NUTS AND REMOVE SOCKET CAP.
- STEP 2. REMOVE OR INSTALL SHIMS AS NECESSARY TO PROVIDE FREE MOVEMENT WITHOUT BINDING OR TOO MUCH FREE PLAY.

MEC 3805-237-12/3-53

Figure 3-58. Lift link shims, removal or installation.

### 3-84. Scarifier Control Shaft

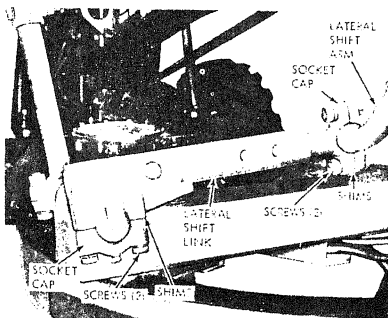
a. *Removal.* Remove scarifier control shaft (fig. 3-40) in the same manner as steering control shaft and front lean wheel control shaft.

b. *Installation.* Install scarifier control shaft (fig. 3-40) in the same manner as steering control shaft and front lean wheel control shaft.

## Section XXI. ADJUSTMENT

### 3-85. Worm Gear End Thrust Bearing

a. *General.* The end thrust bearings in the



- STEP 1. REMOVE TWO SCREWS AND LOCKWASHERS AND REMOVE SOCKET CAP.
- STEP 2. REMOVE OR INSTALL SHIMS AS NECESSARY TO PROVIDE FREE MOVEMENT WITHOUT BINDING OR TOO MUCH FREE PLAY IN LINK.

MEC 3805-237-12/3-54

Figure 3-54. Lateral shift link shims, removal and installation.

control gear boxes of the motor grader aid the clutch anti-coast brake in stopping motion when control lever is disengaged. The thrust bearing should be adjusted periodically, or when coasting of the motion becomes noticeable.

*Note.* Always adjust and thrust bearings before adjusting clutch anti-coast brakes.

#### b. Adjustment.

- (1) Refer to figure 3-56 and loosen the locknut.
- (2) Tighten adjusting screw (fig. 3-56) with allen wrench. Back off screw  $1/16$  to  $1/8$  of a revolution. Tighten locknut.
- (3) Operate control lever and check for coasting. Tighten screw again if necessary.
- (4) Adjust anti-coast brakes (para 3-76) as necessary to aid in prevention of coasting by grader motion.

### 3-86. Power Shift Moldboard

a. *General.* The power shift moldboard is incorporated on the model 440HA motor graders. It is hydraulically actuated, enabling the operator to shift the moldboard to either side

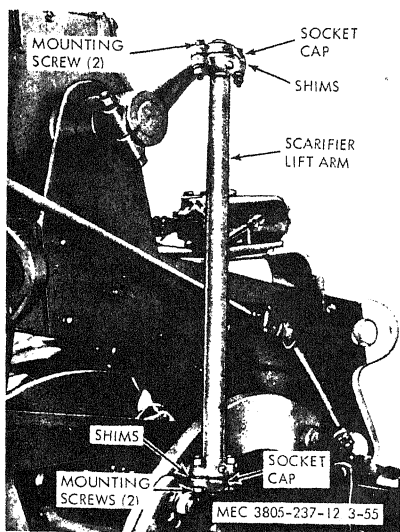
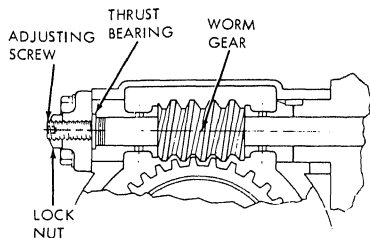


Figure 3-55. Scarifier lift arms, removal and installation.

with a control lever mounted in the operator's compartment. The ball and socket on the hydraulic ram may become worn. Shims must be added or removed to adjust and compensate for wear.

b. Adjustment.

- (1) Remove ball socket cap (fig. 3-52).
- (2) Add or remove shims to adjust for wear.
- (3) Install ball socket cap. Ball and socket should be snug, but operate freely, without binding.



MEC 3805-237-12/3-56

Figure 3-56. End thrust bearing, adjustment.



## APPENDIX A

### REFERENCES

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#### A-1. Fire Protection

TB 5-4200-200-10	Hand Portable Fire Extinguishers Approved for Army Users.
TM 5-687	Repairs and Utilities: Fire Protection Equipment and Appliances; Inspection, Operation, and Preventive Maintenance.

#### A-2. Lubrication

FS C9100-1L	Petroleum, Petroleum-Base Products and Related Materials.
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#### A-3. Preventive Maintenance

TB ENG 347	Winterization Techniques for Engineer Equipment.
TM 9-1870-1	Care and Maintenance of Pneumatic Tires.
TM 9-2858	Cooling Systems: Vehicles and Powered Ground Equipment.
TM 9-6140-200-15	Storage Batteries, Lead-Acid Type.
TM 38-750	Army Equipment Record Procedures.



## APPENDIX B

### BASIC ISSUE ITEMS LIST AND MAINTENANCE AND OPERATING SUPPLIES

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#### Section I. INTRODUCTION

##### B-1. General

Section II lists the accessories, tools, and publications required for maintenance and operation by the operator which are initially issued with, or authorized for use with the motor grader. Section III lists the maintenance and operating supplies required for initial operation.

##### B-2. Explanation of Columns Contained in Section II

a. *Source Codes.* The information provided in each column is as follows:

- (1) *Matériel.* This column is left blank. For identification of agencies assigned supply responsibility for parts, refer to appropriate Federal and Department of Army supply catalogs.
- (2) *Source.* The selection status and source of supply for each part are indicated by one of the following code symbols.
  - (a) P—applied to high-mortality repair parts which are stocked in or supplied from the army supply system, and authorized for use at indicated maintenance categories.
  - (b) P1—applied to repair parts which are low-mortality parts, stocked in or supplied from supply service depots, and authorized for installation at indicated maintenance level.
  - (c) M—applied to repair parts which are not procured or stocked but are to be manufactured at indicated maintenance level.
  - (d) X2—applied to repair parts which are not stocked. The indicated maintenance level requiring such

parts will attempt to obtain them through cannibalization; if not obtainable through cannibalization, such repair parts will be requisitioned with supporting justification through normal supply channels.

- (3) *Maintenance.* The lowest maintenance level authorized to use, stock, install, or manufacture the part is indicated by the following code symbol.

O—Organizational maintenance

- (4) *Recoverability.* Repair parts and/or tool and equipment items that are recoverable are indicated by one of the following code symbols:
  - (a) R—applied to repair parts and assemblies which are economically repairable at direct and general support maintenance activities and normally are furnished by supply on an exchange basis.
  - (b) T—applied to high-dollar value recoverable repair parts which are subject to special handling and are issued on an exchange basis. Such repair parts normally are repaired or overhauled at depot maintenance facilities.
  - (c) U—applied to repair parts specifically selected for salvage by reclamation units because of precious metal content, critical materials, high-dollar value reusable casings, castings, and the like.

*Note.* When no code is shown in the recoverability column the part is considered expendable.

- b. *Federal Stock Number.* When a Federal stock number is available for a part, it will be

shown in this column, and will be used for requisitioning purposes.

*c. Description.*

- (1) The item name and a brief description of the part are shown.
- (2) A five-digit Federal supply code for manufacturer's and/or other supply services is shown in parentheses followed by the manufacturer's part number. This number shall be used for requisitioning purposes when no Federal stock number is indicated in the Federal stock number column.

Example: (08645) 86453

*d. Unit of Issue.* If no abbreviation is shown in this column, the unit of issue is "each".

*e. Quantity Authorized.* This column lists the quantities of repair parts, accessories, tools, or publications authorized for issue to the equipment operator or crew as required.

*f. Quantity Issued with Equipment.* This column lists the quantities of repair parts, accessories, tools, or publications that are initially issued with each item of equipment. Those indicated by an asterisk are to be requisitioned through normal supply channels as required.

*g. Illustrations.* This column is subdivided into two columns which provide the following information:

- (1) *Figure number.* Provides the identification number of the illustration.
- (2) *Item number.* Provides the reference

number for the parts shown in the illustration.

### **B-3. Explanation of Columns Contained in Section III**

*a. Item.* This column contains numerical sequenced item numbers, assigned to each component application, to facilitate reference.

*b. Component Application.* This column identifies the component application of each maintenance or operating supply item.

*c. Source of Supply.* This column is left blank. For identification of agencies assigned supply responsibility for parts, refer to appropriate Federal and Department of Army supply catalogs.

*d. Federal Stock Number.* The Federal stock number will be shown in this column and will be used for requisitioning purposes.

*e. Description.* The item and a brief description are shown.

*f. Quantity Required for Initial Operation.* This column lists the quantity of each maintenance or operating supply item required for initial operation of the equipment.

*g. Quantity Required for 8 Hours Operation.* Quantities listed represent the estimated requirements for an average eight hours of operation.

*h. Notes.* This column contains informative notes keyed to data appearing in the preceding column.

# Section II. BASIC ISSUE ITEMS LIST

Material	Source codes			Federal Stock Number	Description	Unit of Issue	Quantity authorized	Quantity issued with equipment	Illustration	
	Source	Maintenance	Recoverability						Figure	Index no.
					GROUP 31—BASIC ISSUE ITEMS, MANUFACTURER INSTALLED					
					3100—BASIC ISSUE ITEMS, MANUFACTURER OR DEPOT INSTALLED					
	P	0		6140-057-2554	BATTERY: storage dry-charged, Type 6TN (35311-485040)		4	4	3-36	
9	P	0		7510-889-3494	BINDER: loose-leaf, U. S. Army Equipment Log Book		1	1		
9	P	0		7520-559-9618	CASE: operation & maintenance publications, cotton duck, water repellent, mildew resistant, MIL-B-11743B		1	1		
					DEPARTMENT OR THE ARMY OPERATOR & ORGANIZATION MAINTENANCE MANUAL TM 5-3805-237-12		1	1		
				6810-264-9063	SULPHURIC ACID: electrolyte (35311-488141)	GAL	7	7		
		0			TOOL, SCARIFIER TOOTH REMOVING		1	1	3-1	
	P	0		5120-595-9162	WRENCH: allen 9/16 in.		1	*		
	P	0		5120-203-4804	WRENCH: open end 1½ in.		1	*		
					GROUP 32—BASIC ISSUE ITEMS TROOP INSTALLED					
					3200—BASIC ISSUE ITEMS TROOP INSTALLED OR AUTHORIZED					
	P	0		7240-408-3985	MEASURE: liquid, steel zinc coated, 1 qt. funnel spout w/flex extension	EA	1	1		
	P	0		4910-922-6921	KIT, REPAIR: tubeless tire	EA	1	1		

## Section III. MAINTENANCE AND OPERATING SUPPLIES

Item	Component application	Source supply	Federal stock number	Description	Quantity required for maintenance operation	Quantity required for normal operation	Notes
1	0101 CRANKCASE (1)		9150-265-9435 (2) 9150-265-9428 (2) 9150-242-7603 (2)	LUBRICATING OIL: 5 gal pail as follows: OE-30 OE-10 OES	3 gal 3 gal 3 gal	1 qt (3) 1 qt (3) 1 qt (3)	(1) Includes quantity to fill engine oil system, including oil filter.  (2) See FS C9100-IL for additional data and requisitioning procedure.
2	0306 FUEL TANK		9140-252-5294 9140-286-5288 9140-286-5283	FUEL OIL, DIESEL Bulk as follows: DF-2 (4) DF-1 (4) DF-A (4)	60 gal 60 gal 60 gal	(5) (5) (5)	(3) See current LO for grade application and replenishment intervals.  (4) Use DF-2 in temperatures above 32°F. Use DF-1 in temperatures from 32°F to 0°F. Use DF-A in temperatures from 0°F to -65°F.
3	0700 UPPER TRANSMISSION		9150-577-5844 9150-577-5841 9150-257-5440	LUBRICATING OIL GEAR: 5 gal pail as follows: GO-90 GO-80 GOS	2½ gal 2½ gal 2½ gal	(3) (3) (3)	(5) Fuel consumption under normal load is 5 gal per hour of continuous operation. Under full load, maximum consumption is 7 gal per hour.
4	0700 LOWER TRANSMISSION AND FINAL DRIVE		9150-577-5844 9150-577-5841 9150-257-5440	LUBRICATING OIL GEAR: 5 gal pail as follows: GO-90 GO-80 GOS	13 gal 13 gal 13 gal	(3) (3) (3)	
5	0701 TRANSMISSION SHIFTER HOUSING		9150-577-5844 9150-577-5841 9150-257-5440	LUBRICATING OIL GEAR: 5 gal pail as follows: GO-90 GO-80 GOS	4 pt 4 pt 4 pt	(3) (3) (3)	
6	1004 FRONT LEANING WHEEL HOUSING		9150-577-5844 9150-577-5841 9150-257-5440	LUBRICATING OIL GEAR: 5 gal pail as follows: GO-90 GO-80 GOS	4 pt 4 pt 4 pt	(3) (3) (3)	
7	1105 TANDEM DRIVE HOUSING		9150-265-9435 9150-265-9428 9150-242-7603	LUBRICATING OIL: 5 gal pail as follows: OE-30 OE-10 OES	8 gal (6) 8 gal (6) 8 gal (6)	(3) (3) (3)	(6) Four gallons in each side.

8	1204 BRAKE MASTER CYLINDER	9150-190-0932	HYDRAULIC FLUID: 1 pt can as follows: HBA	2½ pt	(3)
9	1413 HYDRAULIC SYSTEM	9150-265-9435 9150-265-9428 9150-242-7603	LUBRICATING OIL: 5 gal pail as follows: OE-30 OE-10 OES	8 gal 8 gal 8 gal	(3) (3) (3)
10	2002 POWER CONTROL BOX HOUSING	9150-265-9435 9150-265-9428 9150-242-7603	LUBRICATING OIL: 5 gal pail as follows: OE-30 OE-10 OES	7 pt 7 pt 7 pt	(3) (3) (3)
11	2002 POWER CONTROL BOX DRIVE HOUSING WITH PUMP ADAPTER	9150-577-5844 9150-577-5841 9150-257-5440	LUBRICATING OIL GEAR: 5 gal pail as follows: GO-90 GO-80 GOS	7½ pt 7½ pt 7½ pt	(3) (3) (3)
12	7439 CIRCLE REVERSE HOUSING	9150-577-5844 9150-577-5841 9150-257-5440	LUBRICATING OIL GEAR: 5 gal pail as follows: GO-90 GO-80 GOS	5 pt 5 pt 5 pt	(3) (3) (3)
13	7439 CIRCLE REVERSE TRANSFER HOUSING	9150-577-5844 9150-577-5841 9150-257-5440	LUBRICATING OIL GEAR: 5 gal pail as follows: GO-90 GO-80 GOS	2½ pt 2½ pt 2½ pt	(3) (3) (3)
14	7439 LATERAL SHIFT HOUSING	9150-577-5844 9150-577-5841 9150-357-5440	LUBRICATING OIL GEAR: 5 gal pail as follows: GO-90 GO-80 GOS	15½ pt 15½ pt 15½ pt	(3) (3) (3)
15	7439 LATERAL SHIFT GEAR REDUCTION HOUSING	9150-577-5844 9150-577-5841 9150-257-5440	LUBRICATING OIL GEAR: 5 gal pail as follows: GO-90 GO-80 GOS	3½ pt 3½ pt 3½ pt	(3) (3) (3)

### Section III. MAINTENANCE AND OPERATING SUPPLIES (Cont.)

Item	Component application	Source of supply	Federal stock number	Description	Quantity required for initial operation	Quantity required for 8 hours operation	Notes
16	7439 LIFT HOUSING		9150-577-5844 9150-577-5841 9150-257-5440	LUBRICATING OIL GEAR: 5 gal pail as follows: GO-90 GO-80 GOS	3 pt 3 pt 3 pt	(3) (3) (3)	
17	7439 LIFT GEAR REDUCTION HOUSING		9150-577-5844 9150-577-5841 9150-257-5440	LUBRICATING OIL GEAR: 5 gal pail as follows: GO-90 GO-80 GOS	3 1/4 pt 3 1/4 pt 3 1/4 pt	(3) (3) (3)	
18	7441 SCARIFIER LIFT HOUSING		9150-577-5844 9150-577-5841 9150-257-5440	LUBRICATING OIL GEAR: 5 gal pail as follows: GO-90 GO-80 GOS	12 1/4 pt 12 1/4 pt 12 1/4 pt	(3) (3) (3)	
19	7441 SCARIFIER GEAR REDUCTION HOUSING		9150-577-5844 9150-577-5841 9150-257-5440	LUBRICATING OIL GEAR: 5 gal pail as follows: GO-90 GO-80 GOS	1 1/2 pt 1 pt 3 pt	(3) (3) (3)	
20	LUBRICATION FITTINGS		9150-190-0905	GREASE, AUTOMOTIVE AND ARTILLERY: GAA	2 shots w/grease gun	5 shots w/grease gun	



## APPENDIX C

### MAINTENANCE ALLOCATION CHART

#### Section I. INTRODUCTION

##### C-1. General

a. Section I provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. Section II designates overall responsibility for the performance of maintenance operations on the identified item or component. The implementation of the maintenance tasks upon the end item or component will be consistent with the assigned maintenance operations.

c. Section III lists the special tools and test equipment required for each maintenance operation as referenced from Section II.

d. Section IV contains supplemental instructions, explanatory notes and/or illustrations required for a particular maintenance function.

##### C-2. Explanation of Columns in Section II

a. *Functional Group Number.* The functional group is a numerical group set up on a functional basis. The applicable functional grouping indexes (obtained from TB 750-93-1 Functional Grouping Codes) are listed on the MAC (Maintenance Allocation Chart) in the appropriate numerical sequence. These indexes are normally set up in accordance with their function and proximity to each other.

b. *Component Assembly Nomenclature.* This column contains a brief description of the components of each functional group.

c. *Maintenance Operations and Maintenance Levels.* This column lists the various maintenance operations (A through J) and indicates the lowest maintenance level authorized to perform these operations. The symbol designation for the various maintenance levels are as follows:

- O/C—Operator or crew
- O —Organizational maintenance
- F —Direct support maintenance

- H —General support maintenance
- D —Depot maintenance

The Maintenance Operations are defined as follows:

- A—Service: Operations required periodically to keep the item in proper operating condition, i.e., to clean, preserve, drain, paint and replenish fuel, lubricants, hydraulic and deicing fluids, or compressed air supplies.
- B—Adjust: Regulate periodically to prevent malfunction. Adjustments will be made commensurate with adjustment procedures and associated equipment specifications.
- C—Align: Adjust two or more components of an electrical or mechanical system so that their functions are properly synchronized or adjusted.
- D—Calibrate: Determine, check, or rectify the graduation of an instrument, weapon, or weapons system or components of a weapons system.
- E—Inspect: Verify serviceability and detect incipient electrical or mechanical failure by close visual examination.
- F—Test: Verify serviceability and detect incipient electrical or mechanical failure by measuring the mechanical or electrical characteristics of the item and comparing those characteristics with authorized standards. Tests will be made commensurate with test procedures and with calibrated tools and/or test equipment referred in the MAC.
- G—Replace: Substitute serviceable components, assemblies and subassemblies for unserviceable counterparts or remove and install the same item when required for the performance of other maintenance operations.

**H—Repair:** Restore to a serviceable condition by replacing unserviceable parts or by any other action required using available tools, equipment and skills—to include welding, grinding, riveting, straightening, adjusting and facing.

**I—Overhaul:** Restore an item to a completely serviceable condition (as prescribed by serviceability standards developed and published by the commodity commands) by employing techniques of "Inspect and Repair Only as Necessary" (IROAN). Maximum use of diagnostic and test equipment is combined with minimum disassembly during overhaul. "Overhaul" may be assigned to any level of maintenance except organizational, provided the time, tools, equipment, repair parts authorization, and technical skills are available at that level. Normally, overhaul as applied to end items, is limited to depot maintenance level.

**J—Rebuild:** Restore to a condition comparable to new by disassembling to determine the condition of each component part and reassembling using serviceable, rebuilt, or new assemblies, subassemblies, and parts.

**d. Reference Note.** This column, subdivided into columns K and L, is provided for referencing the SPECIAL TOOL AND TEST EQUIPMENT REQUIREMENTS (sec. III)

and REMARKS (sec. IV) that may be associated with maintenance operations (sec. II).

### **C-3. Explanation of Columns in Section III**

**a. Reference Code.** This column consists of a number and a letter separated by a dash. The number references the T & TE requirements column on the MAC. The letter represents the specific maintenance operation the item is to be used with. The letter is representative of columns A through J on the MAC.

**b. Maintenance Level.** This column shows the lowest level of maintenance authorized to use the special tool or test equipment.

**c. Nomenclature.** This column lists the name or identification of the tool or test equipment.

**d. Tool Number.** This column lists the manufacturer's code and part number, or Federal stock number, of tools and test equipment.

### **C-4. Explanation of Columns in Section IV**

**a. Reference Code.** This column consists of two letters separated by a dash, both of which are references to section II. The first letter references column L and the second letter references a maintenance operation, column A through J.

**b. Remarks.** This column lists information pertinent to the maintenance operation being performed, as indicated on the MAC, section II.

## Section II. MAINTENANCE ALLOCATION CHART

Functional code number	Component Assembly Nomenclature	Essentiality	Maintenance levels										Note ref	
			Maintenance operations										K	L
			A	B	C	D	E	F	G	H	I	J		
	Component Assembly Nomenclature		Service	Adjust	Align	Calibrate	Inspect	Test	Replace	Repair	Overhaul	Rebuild	T&E rmt	Remarks
01	ENGINE													
0100	Engine Assembly: Engine -----		O/C				O/C	F	F	F	H			A
0101	Crankcase, Block, Cylinder Head: Block ----- Head, cylinder -----									H H				
0102	Crankshaft: Bearings, main ----- Crankshaft ----- Damper, pulley -----									H H F	D			B
0103	Flywheel Assembly: Cover ----- Flywheel, housing, ring gear -----									O F				
0104	Pistons, Connecting Rods: Bearings, pistons, pins, retainers ----- Rods, connecting, rings -----									H H	H			
0105	Valves, Camshafts, and Timing System: Arm, rocker ----- Bearings, camshaft, cover, timing ----- Gear, gears timing chain ----- Cover, rocker arm ----- Gear, idler ----- Guides, springs, retainers ----- Rods, push ----- Tappets ----- Valves, seats -----			F						F H H O H H H H F F				C
0106	Engine Lubricating System: Breather ----- Cap, filler, fittings, hose, Lines, pipes ----- Gage, level ----- Pump, oil -----		O/C							O O O/C F				
0108	Manifolds: Manifolds -----								O					
0109	Accessory Driving Mechanisms: ----- Accessor drive -----									H	H			

## Section II. Maintenance Allocation Chart—Continued

Functional group number	FOR:	Maintenance levels											Note ref		
		Maintenance operations													
		Essentiality	A	B	C	D	E	F	G	H	I	J		K	L
			Service	Adjust.	Align	Calibrate	Inspect	Test	Replace	Repair	Overhaul	Rebuild		T&TE reqmt	Remarks
	Component Assembly Nomenclature														
02	CLUTCH														
0200	Clutch Assembly: Clutch assembly ----- Disks, plates -----			F				F	F	H					
0202	Clutch Release Mechanism: Bearings, shaft, yoke ----- Pedal, linkage -----		O						F						
0206	Clutch Brake: Hub, plate -----								F						
03	FUEL SYSTEM														
0301	Fuel Injector: Injector, fuel -----							F	H						
0302	Fuel Pumps: Plunger assembly ----- Pump, diesel injector ----- Pump, fuel transfer -----		O/C					O	F	H			D		
0304	AIR CLEANER: Cleaner, air, cartridge -----		O/C						O						
0306	Tanks, Lines, Fittings: Cap, fittings ----- Lines ----- Tank -----								O	O					
0308	Engine Speed Governor & Controls: Governor ----- Linkage, rod, lever -----								F	D					
0309	Fuel Filters: Filter, fuel -----		O/C						O						
0312	Accelerator, Throttle: Linkage, pedal -----								O						
04	EXHAUST SYSTEM														
0401	Muffler and Pipes: Muffler, pipes, clamps, cap -----								O						
05	COOLING SYSTEM:														
0501	Radiator: Cap ----- Core, tanks ----- Grille ----- Radiator -----								O/C						
0502	Shroud: Covers, shroud -----		O/C					O/C	O						

## Section II. Maintenance Allocation Chart—Continued

Functional group number	FOR:	Essentiality	Maintenance levels										Note ref		
			Maintenance operations										K	L	
			A	B	C	D	E	F	G	H	I	J			
			Service	Adjust	Align	Calibrate	Inspect	Test	Replace	Repair	Overhaul	Rebuild			
Component Assembly Nomenclature														T&TE reqmt	Remarks
0503	Thermostats & Housing Gaskets: Hoses, pipes, clamps, lines, Fittings ----- Housing ----- Thermostat -----							O O O							
0504	Water pump: Pump, water -----							O	F						
0505	Fan Assembly: Belt, V ----- Fan, guard ----- Tightener, belt -----			O/C				O O O							
06	ELECTRICAL SYSTEM														
0601	Generator: Belt, V ----- Brushes ----- Generator -----			O/C				O O O		F					
0602	Generator Regulator: Regulator, generator -----			O				O	O						
0603	Starting Motor: Brushes, solenoid ----- Starter -----			O/C				O	O	F					
0607	Instrument or Engine Control Panel: Gages, switches, lamp, lights ----- Panel, control ----- Wiring -----								O F		O				
0608	Miscellaneous Items: Receptable, charging ----- Wiring -----								O		O				
0609	Lights: Lamps ----- Lens, doors, gaskets ----- Lights, head, tail, blackout -----								O/C O O						
0611	Horn: Horn, switch ----- Wiring -----								O		O				
0612	Batteries: Batteries ----- Box, battery ----- Cables -----			O/C				O	O O O		O				
0613	Chassis Wiring Harness: Harness wiring -----							F	O						

## Section II. Maintenance Allocation Chart—Continued

Functional group number	FOR:	Essentiality	Maintenance levels											Note ref	
			Maintenance operations											K	L
			A	B	C	D	E	F	G	H	I	J			
	Component Assembly Nomenclature		Service	Adjust	Align	Calibrate	Inspect	Test	Replace	Repair	Overhaul	Rebuild	T&TE reqmt	Remarks	
0615	Radio Interference Suppression: Components -----							O	O						
07	TRANSMISSION:														
0700	Transmission Assembly: Case, transmission ----- Cover ----- Transmission -----		O/C				O/C			H	O				
0701	Transmission Shafts: Shafts, gears, bearings, seals -----									H					
0702	Opposed Output: Shafts, gears, bearings, retainers -----									H					
0704	Transmission Top Cover Assembly: Levers, linkage ----- Shifter, forks, shafts, seals -----									O	H				
0710	Transmission Assembly: (hydraulic) Bearings, covers, gaskets, gears planetary units, plugs & shafts -----									H					
0721	Lubricating Components: Filter, oil, breather ----- Fitting, tube ----- Line, fittings ----- Pump, oil -----		O/C							O	H				
										O	H				
										O	F				
10	FRONT AXLE														
1000	Front Axle Assembly: Axle assembly front -----		O/C							F	F				
1004	Steering & Wheel Leaning Mechanism: Gear box assembly ----- Knuckles, arms, shafts, bearings seals, flanges, pins gear case, gears ----- Shafts, bushings ----- Shafts, control joints, universal -----		O/C				O/C			F	O				
										O	O				
11	REAR AXLE														
1100	Rear Axle Assembly: Chain ----- Shafts, sprockets, bearings, Seals, retainers, spacers, gears -----									F	F				
										H					

## Section II. Maintenance Allocation Chart—Continued

Functional group number	FOR:	Essentiality	Maintenance levels											Note ref	
			Maintenance operations											K	L
			A	B	C	D	E	F	G	H	I	J			
			Service	Adjust	Align	Calibrate	Inspect	Test	Replace	Repair	Overhaul	Rebuild	T&TE eqmt		
Component Assembly Nomenclature															
1105	Tandem Drive Assembly:														
	Case -----							H							
	Covers, breather -----							O							
	Drive, tandem -----		O/C				O/C								
12	BRAKES														
1201	Hand Brakes:														
	Band, brake -----							F	F						
	Drum -----							F							
	Levers, linkage -----		O/C					O							
1202	Service Brakes:														
	Brakes, service -----			O				F	F						
1204	Hydraulic Brakes System:														
	Cylinder, master -----		O/C				O/C	O	F						
	Cylinder, wheel -----							O	F						
	Lines, hose, fittings -----							O							
1206	Mechanical Brake Controls:														
	Pedal, brackets, linkage, rods -----							O							
13	WHEELS														
1311	Wheel Assembly:														
	Bearings -----		O/C					O							
	Wheel, rim, seals, studs -----							O							
1313	Tires:														
	Tires -----		O/C					O							
14	STEERING														
1401	Steering Assembly:														
	Shafts, draglinks, arm -----		O/C					O	O						
	Steering gear assembly -----		O/C					O	F						
	Wheel -----							O							
1410	Hydraulic Pump:														
	Coupling, drive -----							O							
	Pump, hydraulic -----							O	F						
1411	Hose, Lines, Fittings:														
	Hose, lines, fittings -----							O							
1412	Hydraulic Cylinders:														
	Cylinder, hydraulic -----							F	F						
1413	Tanks:														
	Cap -----							O/C							
	Tank assembly -----		O/C						F						
1414	Steering System Valves:														
	Valve assemblies -----							O	F						
15	FRAME, TOWING ATTACHMENTS														
1501	Frame Assembly:														
	Frame assembly -----								H						

## Section II. Maintenance Allocation Chart—Continued

Functional group number	FOR:	Essentiality	Maintenance levels										Note ref	
			Maintenance operations										K	L
			A	B	C	D	E	F	G	H	I	J		
	Component Assembly Nomenclature		Service	Adjust	Align	Calibrate	Inspect	Test	Replace	Repair	Overhaul	Rebuild	T&TE reqmt	Remarks
1503	Pintles & Towing Attachments: Hook, pintle ----- Shackle -----		O/C							O				
18	CAB, HOOD													
1801	Cab, Hood: Cab, sheets ----- Fastner, hood ----- Hood ----- Panels, hood -----								O					
1805	Floors: Floor, sheet -----								O					
1808	Seats: Seat -----								O					
1808	Boxes: Box, tool -----								O					
20	POWER CONTROL UNIT													
2002	Power Control Unit Assembly: Control assembly ----- Levers ----- Pin, shear ----- Shaft, propeller ----- Shafts, case, yokes, seals -----		O/C				O/C		O		O			
22	ACCESSORY ITEMS													
2210	Data Plates: Plates, data ----- Plates, instruction & identification -----								F					
43	HYDRAULIC SYSTEM													
4301	Filters, Hoses, Fittings, Tubing: Filter, hydraulic oil ----- Hoses, tubes, fittings ----- Junction assembly -----		O/C						O					
4305	Control Valves: Valves -----									F				
4307	Hydraulic Cylinders: Cylinder, hydraulic -----									F				
47	GAGES AND MEASURING DEVICES													



## Section II. Maintenance Allocation Chart—Continued

Functional group number	FOR:	Essentially	Maintenance levels											Note ref	
			Maintenance operations											K	L
			A	B	C	D	E	F	G	H	I	J			
	Component Assembly Nomenclature		Service	Adjust	Align	Calibrate	Inspect	Test	Replace	Repair	Overhaul	Rebuild	T&TE reqmt	Remarks	
4702	Gages, mountings, lines, & fittings: Gages ----- Gage, fuel -----								O O						
4703	Hourmeter: Hourmeter -----								O						
74	EARTH MOVING EQUIP- MENT COMPONENTS														
7435	Moldboard Assembly: Blade assembly ----- edges, bits -----								O O/C	O					
7436	Lift Arms and Pivot Assemblies: Bar, links, arms -----		O/C												
7438	Circle and Drawbar Assembly: Circle, drawbar ----- Shims -----		O/C						F O						
7439	Circle Reverse Drawbar Side Shift & Lift Mechanism: Cases, gears, shafts, seals, bearings ----- Gear box assembly ----- Joints, universal ----- Pins -----		O/C				O/C		F O O O		O				
7440	Scarifier Assembly: Drawbar, rods, bushings, angle adjustments, shanks ----- Teeth -----								O O/C						
7441	Scarifier Actuating: Gear box assembly ----- Joints, universal ----- Shafts, arms, bushings ----- Shafts, gear cases, gears, bearings, seals -----		O/C				O/C		O O F	O					
76	FIRE FIGHTING EQUIPMENT														
7603	Fire Extinguishers: Extinguisher, fire -----		O/C				O/C								

**Section III. SPECIAL TOOL AND SPECIAL TEST EQUIPMENT REQUIREMENTS**

Reference code	Maintenance level	Nomenclature	Tool number
4	O/C	Remover, scarifier point	429581 (35311)

**Section IV. REMARKS**

Reference code	Remarks
A-F	Test includes engine operation and compression
B-H	Repair includes metalizing, grinding and alining
C-G	Camshaft removal necessary
D-F	Test for proper fuel pressure
E-G	Internal
F-G	External

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For explanation of abbreviations used, see AR 320-50.